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Focus Groups Exploring U.S. Adults' Knowledge, Attitudes, and Practices Related to Irradiation as a Food Safety Intervention, 2021

ABSTRACT

Food irradiation has been studied comprehensively and has been determined to be a safe and effective process for improving food safety. Despite this potential public health impact and current use in developed countries, the technology is not commonly used in the United States, with consumer acceptance often cited as a barrier. Given changes in consumer food-purchasing trends, advancements in irradiation technology, and an increase in multistate foodborne outbreaks, it is an opportune time to revisit consumer acceptance and factors that influence the purchase of irradiated food. We conducted seven focus groups to assess knowledge, attitudes, and practices regarding irradiation as a food safety intervention. Meetings were virtual, lasted 90 min, and were held March 15–18, 2021. Participants were stratified into three groups using quota sampling: adults aged 18–64 years, parents of children aged 0–4 years, and adults aged 65 years and older. Consistent with past research, consumers were unaware of what food irradiation is. Facilitators for purchasing irradiated foods included protection from foodborne illness, reduced risk from certain foods, and support from public health agencies. Barriers included lack of knowledge, safety concerns, price, packaging, and a distrust of food technology. The results from these focus groups can inform public messaging and foodborne illness prevention strategies.

INTRODUCTION

Food irradiation is a technology used in food production that treats food with ionizing radiation to improve safety and extend shelf life *(34)*. Like pasteurization, energy is applied to reduce or eliminate microorganisms and insects. Food irradiation is unique because the ionizing radiation transfers energy without a significant rise in temperature. Food irradiation has been studied since the early 1900s and has been determined to be safe and effective. Changes in nutritional content as a result of irradiation did not differ from those produced by cooking or other food processing techniques *(27, 35)*. Globally, food irradiation has been approved in 41 countries for more than 30 products *(3)*.

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Food irradiation could substantially reduce foodborne illness. It has been estimated that irradiating 50% of meat and poultry in the United States could prevent an estimated 853,000 cases of *Salmonella, Campylobacter,* and *Escherichia coli* O157 infections; 7,300 hospitalizations; and 185 deaths per year *(29)*. However, the potential public health impact of irradiation extends beyond meat and poultry *(26, 34)*. Increasingly, foodborne outbreaks have been linked to produce, which is often consumed raw *(5)*. Produce is estimated to account for approximately 38% of foodborne *Salmonella* infections and 64% of foodborne Shiga toxin–producing *E. coli* infections *(17)*. Irradiation may be particularly useful for produce that is consumed raw, because there are often no other steps consumers can take to reduce or eliminate any bacteria present (e.g., cooking). However, food irradiation in the United States has largely only been used for pest control in spices, grains, and fruits *(20)*. Despite food irradiation's documented safety, current global usage, and potential public health impact, the technology is largely underutilized for food safety in the United States; consumer acceptance is often cited as a significant barrier *(6, 22)*.

Given possible changes in consumers' awareness of and concern about foodborne illness and changes in consumer food-purchasing trends over the last 30 years, it is an opportune time to revisit consumer acceptance of food irradiation in today's context to inform foodborne illness prevention efforts. Consumer acceptance research on food irradiation was largely conducted in the 1990s and early 2000s. Over the last decade, the number of large, multistate foodborne outbreaks has increased *(24)*. Several large, multistate outbreaks, such as the *E. coli* O157 outbreaks linked to romaine lettuce during 2018–2019 *(23)* and the *Salmonella* Newport outbreak linked to ground beef during 2018 *(7)*, received a considerable amount of media attention and had major impacts on the affected supply chains. Research has also identified consumers' growing expectation for food safety, especially for meats *(18)*.

The purpose of this project was to assess current consumer knowledge, attitudes, and practices toward irradiation as a food safety intervention and identify barriers and facilitators to purchasing irradiated food in today's context. The findings of this project will help identify key components to consumer acceptance of irradiated foods to help inform consumer-driven educational interventions for irradiated foods within the United States.

MATERIALS AND METHODS

This activity was reviewed by the Centers for Disease Control and Prevention (CDC) and was conducted consistent with applicable federal law and CDC policy. We conducted seven focus groups (56 total participants) to assess knowledge, attitudes, and practices regarding irradiation as a food safety intervention. All meetings were held virtually via Zoom, were 90 min in length, and were conducted March 15–18, 2021. Participants were stratified into three groups: adults aged 18–64 years, parents of children aged 0–4 years, and adults aged 65 years and older. These groups were chosen because children younger than 5 years and adults aged 65 years and older are at higher risk for serious health complications from foodborne illness *(8)*. Each participant received $75 for participation.

Sampling and participant screening

Hager Sharp (Washington, D.C.) worked with a national market research recruitment vendor to recruit participants for the groups. The market research firm maintains a national database that individuals opt into to participate in studies for which they are eligible. Individuals who responded to the initial call for participants for this study then underwent additional screening for eligibility. All demographic characteristics were self-identified by participants during the recruitment process, and all individuals screened were over the age of 18 years. There were five exclusion criteria for participant screening: (1) having participated in a focus group within the past 6 months; (2) being employed by a market research company, an advertising agency or public relations firm, or the media or a being a healthcare professional; (3) not having access to a computer or mobile device with a web camera and high-speed internet; (4) not doing at least half of the grocery shopping for one's household; and (5) not comfortable speaking and reading in English. If respondents met the recruitment criteria, they were provided with the study objectives, purpose, participation requirements, activities the study entailed, and potential risks associated with participation. If respondents agreed to participate, their contact information, including telephone numbers and email, were collected. A confirmation email was then sent that included the date, time, and link to participate in the focus groups. Participants also received a telephone reminder at least 24 h before the session to confirm participation.

A quota sampling method was used to select participants from the market research vendor's recruitment database to form a sample with varying demographic characteristics. Quota sampling is a nonrandom sampling technique in which participants are chosen based on predetermined characteristics so that the total sample will have distribution of characteristics similar to that of the target population *(28)*. This sampling strategy was chosen to help explore consumer knowledge, attitudes, and practices toward food irradiation among groups diverse in age, sex, race or ethnicity, education, urbanicity, and attitudes toward food technology. Urbanicity was measured using the Office of Management and Budget definition *(31)*. Attitudes toward food technology were assessed through two screening questions that asked to what extent participants agreed with the following statements: (1) "I avoid purchasing and eating GMO, or genetically modified, foods," and (2) "As much as possible, I only purchase and

TABLE 1. Focus group shopping scenarios with choice of irradiated and non-irradiated ground beef in different packages and prices

Scenario	Irradiated (price)	Non-irradiated (price)	Packaging
1	$5.42	$5.42	Both: tray
2	$4.35	$5.42	Both: tray
3	$6.49	$5.42	Both: tray
4	$5.42	$5.42	Irradiated: tray Non-irradiated: chub
5	$5.42	$5.42	Irradiated: chub Non-irradiated: tray

eat organic foods." Attitudes toward food technology were captured to ensure that participants represented a range of perspectives and experiences related to food safety or technology in food processing.

Data collection and analysis

Interview guides included questions about participants' knowledge, attitudes, and practices regarding irradiation as a food safety intervention. Questions related to knowledge about irradiation were asked first, including "Have you heard of food irradiation?" "What is food irradiation?" and" Why is food irradiated?" An excerpt about food irradiation was then read to the participants: "Food irradiation is a technology that can make food safer for you by reducing the germs that cause foodborne illness. Foodborne illness, sometimes called 'food poisoning,' happens when people eat or drink food or beverages contaminated with bacteria or germs and can lead to a range of sicknesses—from mild discomfort to very serious, life-threatening illness. Food irradiation reduces the germs that cause foodborne illness through the application of ionizing radiation to food and, like pasteurizing milk and canning fruits and vegetables, makes food safer for you to eat. Many studies over the last three decades have shown that irradiation is a safe way to reduce germs in foods and is not harmful to humans. In fact, treating food with irradiation can lower the presence of bacteria by up to 99.99%. Irradiation does not make foods radioactive or compromise nutritional quality, and it has limited to no effect on the taste, texture, or appearance of food. In fact, any changes made by irradiation are so minimal that it is not easy to tell if a food has been irradiated."

After the excerpt was read, participants were asked questions about their attitudes toward food irradiation, including "How likely are you to purchase irradiated foods?" "What influences this decision?" and "Who do you think would buy irradiated foods?" Lastly, questions focused on consumer practices for irradiated foods. Participants were given five shopping scenarios that asked them to choose between an irradiated package of ground beef and a nonirradiated package of ground beef *(Table 1)*. For these scenarios, two images appeared on the screen. Participants were asked to choose which one they would purchase using the polling feature on Zoom. After all participants had selected a product, participants were asked about their rationale to gather feedback on facilitators and barriers to purchasing irradiated foods. Scenarios manipulated both price (20% increase or decrease) and packaging of irradiated and nonirradiated ground beef to assess their impact on purchasing decisions for irradiated ground beef. The order in which the scenarios were presented was randomized; participants were asked to assume that each option had the same nutrition, taste, texture, and appearance.

Focus group sessions were audio and video recorded. Verbatim transcripts were developed by a transcription vendor (GMR Transcription Services, Inc., Seattle, WA) employing a two-phase accuracy and completeness evaluation *(10)*. Each participant was identified by a unique identifier; names and other means of identification were not used in the notes or in the transcripts to protect participants' identities and maintain confidentiality. All transcripts and recordings were maintained on a secure password-encrypted computer.

Transcripts were reviewed for accuracy and completeness. Using the applied thematic analysis framework *(13)* and Dedoose 8.2.14 qualitative analysis software (SocioCultural Research Consultants, Manhattan Beach, CA), two members of the research team reviewed the transcripts with the goal of identifying common themes among participants, areas of consensus, and areas in which participants differed in their perspectives and experiences. The preliminary codebook was reviewed and approved by project team members. Two coders conducted analyses, each independently coding two of the same transcripts so that interrater reliability could be assessed. Using a random sample of excerpts and codes, coders had 0.748 pooled Cohen's kappa for set 1 data

and 0.780 pooled Cohen's kappa for set 2 data, indicating substantial agreement *(21)*. Key themes were identified based on this procedure, including concerns about foodborne illness and motivators, barriers, and facilitators to purchasing irradiated foods. Themes were identified as important either because many participants expressed them or because a few participants emphasized them through frequent references or nonverbal cues.

RESULTS

We conducted seven focus groups (56 total participants): three groups of parents of children aged 0–4 years (23 participants), two groups of adults aged 65 years and older (17 participants), and two groups of adults aged 18–64 years (16 participants) *(Table 2)*. Combining the parent and adult groups, among the 56 participants, 39 (69%) were aged 18–64 years and 17 (31%) were 65 years and older. Twenty (35%) participants identified as male, and 36 (63%) participants identified as female. Thirty-four (60%) participants identified as White, 18 (32%) participants identified as Black or African American, and 4 (7%) participants identified as Asian. Seven (12%) participants identified as Hispanic, and nine (86%) participants identified as non-Hispanic. Twenty-eight (49%) participants had obtained a bachelor's degree or higher, and 45 (79%) participants lived in suburban or urban settings. Thirty-one (54%) participants agreed with the statement "I avoid purchasing and eating GMO, or genetically modified, foods," and 29 (51%) participants agreed with the statement "As much as possible, I only purchase and eat organic foods."

Consumer knowledge of food irradiation

Most participants were not familiar with the term irradiation, and the few who reported they had heard the term mostly had limited knowledge of what irradiation is and how it is used. Some participants in both older adult groups included individuals who were familiar with irradiation, including the process and purpose. One participant stated, "It's used in a lot of different fields…primarily to sterilize devices that are used in the hospital. And it makes total sense to irradiate.… I mean it doesn't affect them otherwise."

Perceived benefits of and concerns about food irradiation

Benefits. Participants were read a description of food irradiation and its benefits and were asked to discuss some potential benefits and concerns with the process. Participants stated that the primary benefit of food irradiation is to protect consumers from foodborne illness. One participant stated, "But if the foods don't become radioactive and it doesn't compromise the quality of the foods, and if it kills bacteria like it says, 99.99, then it sounds like a good practice to keep us safe."

Concerns. Concerns related to food irradiation centered on perceived short- and long-term health effects, reduction in the quality and nutritional value of food, increase in price from additional food processes, and general concerns related to radiation and radioactivity. Parents of children aged 0–4 years were especially concerned about health effects that may affect their children. One participant stated, "I'm concerned more about the long-term.… I'm not concerned about myself. More for my kids when they will grow up eating the stuff that has been irradiated. So, what will be the effect on their bodies?" Participants also had many questions about the technology. Commonly asked questions were primarily related to the food irradiation process, the effectiveness, the safety, and whether or how irradiated foods are currently sold.

Barriers and facilitators to purchasing irradiated foods

Overall, we identified six themes common among participants related to barriers and six themes related to facilitators for purchasing irradiated foods generally and for ground beef specifically. Barriers included general safety concerns about irradiation, a lack of familiarity with irradiated foods, the perception that irradiation is unnecessary, a general distrust of food technology, higher price, and chub, or tube, packaging (for ground beef specifically). Facilitators included lower price, familiar tray packaging (for ground beef specifically), general protection from foodborne illness, reduced risk from certain foods, support from public health agencies, and positive anecdotes and evidence demonstrating safety and benefits of irradiated foods.

Barriers. Four themes related to barriers were identified through discussion outside of the shopping scenarios. They were general safety concerns about irradiation (as described earlier), a lack of familiarity with irradiated foods, the perception that irradiation is unnecessary, and a general distrust of food technology. However, for general safety concerns and a lack of familiarity, participants indicated these barriers could be overcome with more education about food irradiation. For example, those who identified a lack of familiarity with irradiated foods as a reason they wouldn't buy them also mentioned that they may purchase them after learning more. One participant stated, "I don't know that, like, I would go out and buy something right now, but hearing more about it and the process…and researching it does make me a little more comfortable." For those who felt irradiation was unnecessary, they often explained how they were able to take care of food safety concerns at home, whether it be through cooking or cleaning food. One participant stated, "I mean you're going to bring it home, and you're going to do whatever you have to do to make sure that it's clean and it's safe for your family." Another stated, "Unless I'm eating it raw, I think the cooking process is going to take care of most anything that I'd be concerned about anyway." Lastly, those who expressed a general distrust of food technology often mentioned how foods can be overprocessed to extend shelf life as opposed to natural and organic products that they perceived as being healthier. One participant stated,

TABLE 2. Focus groups assessing knowledge, attitudes, and practices toward food irradiation among U.S. adults: participant demographics

	Total (n = 56)	
	No. of participants	% of all participants
Age range (years)		
18–29	1	2
30–49	34	60
50–64	4	7
65+	17	30
Sex		
Male	20	35
Female	36	63
Race		
Asian	4	7
Black or African American	18	32
White	34	60
Ethnicity		
Hispanic	7	12
Non-Hispanic	49	88
Education		
High school diploma or less	8	14
Some college but no degree	20	35
College degree	19	33
Master's degree (e.g., M.A., M.S.)	9	16
Professional degree (e.g., M.D., J.D.) or doctorate (e.g., Ph.D., Ed.D.)	0	0
Urbanicity[a]		
Urban	15	26
Rural	11	19
Suburban	30	53
Extent of agreement with "I avoid purchasing and eating GMO, or genetically modified, foods."		
Strongly disagree	11	19
Somewhat disagree	14	25
Somewhat agree	19	33
Strongly agree	12	21
Extent of agreement with "As much as possible, I only purchase and eat organic foods."		
Strongly disagree	9	16
Somewhat disagree	18	32
Somewhat agree	18	32
Strongly agree	11	19

[a]Urbanicity was defined using OMB's definitions. An urban area refers to a population of 50,000 or more, and a suburban area refers to a population of at least 10,000 (but less than 50,000). All counties that were not classified as urban or suburban were considered rural.

"It's just like organic. I mean, you know that you're going to pay in some cases a dollar or two more.… But my personal opinion…is that it's more about the shelf life…so they don't have to throw out as opposed to what's really better for us."

The other two identified themes related to barriers were higher price and chub packaging, and these were identified through thematic analysis of the virtual ground beef shopping scenarios. The lower-price ground beef product was almost always chosen over the higher-price ground beef product, regardless of whether it was irradiated. When presented with options in which the irradiated ground beef cost less and the packaging was the same, most participants would choose the cheaper irradiated ground beef. However, some participants still were not willing to take on the perceived risk of consuming irradiated ground beef. Similarly, in scenarios in which the irradiated ground beef cost more and the packaging was the same, most participants indicated that they would purchase the cheaper nonirradiated ground beef, expressing that the potential benefits of irradiation were not worth the higher price. One participant stated, "I will go with the lower price. Because I just don't know enough about the other one to really pay more for it." However, a few participants throughout the groups stated they would be willing to pay more for irradiated ground beef—if the price was "reasonable"—for the guarantee of safety. One of these participants stated, "Just having that peace of mind…I can put that in my cart—because we buy grass-fed beef and pay an extra price for it, when you know, there's regular beef. So, to me, that would be the equivalent of that."

Most participants preferred tray packaging for ground beef compared with chub, or tube, packaging, citing reasons such as lack of familiarity with chub packaging and not being able to see the color or assess the freshness of the meat. One participant stated a preference for tray packaging because "You can actually see the product and know whether it's fresh or not. Whereas, in the—in the rolled thing, you can't tell what it looks like to see if maybe it's gone bad or something like that." In scenarios in which irradiated ground beef was in tray packaging and nonirradiated ground beef was in chub packaging, most participants would choose the irradiated ground beef in tray packaging. This was also true for participants who said they would not normally choose the irradiated option. One participant stated, "I've never really eaten meat from a tube, so I guess the packaging for me was a little bit—you know. I guess I feel like it's fresher." In scenarios in which the irradiated ground beef was in chub packaging and the nonirradiated ground beef was in a tray, most participants would choose the nonirradiated ground beef. In all scenarios in which participants indicated they would choose the ground beef packaged in a chub, it was from a familiarity with the packaging, often citing past purchases. One participant stated, "I have bought [chub-packed meat] plenty of times. It's just, they can weigh the same pounds. But…the roll is cheaper than the other pack." When participants were presented with irradiated and nonirradiated ground beef that had both the same cost and the same packaging, most participants would choose the nonirradiated option, citing familiarity with the product and concerns previously mentioned.

Facilitators. Four additional themes related to facilitators were identified through discussion outside of the shopping scenarios. They were a general protection from foodborne illness, reduced risk from certain foods, support from public health agencies, and positive anecdotes and evidence demonstrating safety and benefits of irradiated foods. Two themes related to facilitators to purchasing irradiated ground beef were identified through the virtual shopping scenarios: lower price and familiar packaging (tray packaging).

Several participants identified protection against foodborne illness, for themselves, their children, or their family, as a benefit of irradiation. One participant stated, "I don't like to have to worry about foodborne illnesses.… So to know that there was an extra step to make sure that any kind of germ that could make the meat bad was irradiated out of it…that doesn't scare me." Some participants pointed out that there are certain foods, such as leafy greens and ground beef, that they feel are more likely to carry foodborne germs and are more difficult to prepare in a way that eliminates the risk of illness, making these foods more appealing to purchase irradiated. One participant stated, "Lettuce. Those leafy greens that have caused a lot of foodborne illnesses. I definitely would prefer it irradiated." Another added, "Ground beef is a real scary purchase for me because they say when we buy commercial hamburger in the market, that may be from 100 cows all mixed together.… So, especially for something like ground beef—that would really cut the risk." Support for irradiation from public health agencies, such as the CDC, the U.S. Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), and the World Health Organization (WHO), and positive anecdotes from friends, family, and the public demonstrating the safety and benefits of irradiated foods were also identified as facilitators for purchasing irradiated foods. One participant stated, "If it is something that the CDC is backing, I'll lean a little more that way."

DISCUSSION

Irradiation is a food safety technology that is safe, is effective, and has a large potential public health impact *(29)*. Despite this, food irradiation remains largely underutilized in the United States compared with its use in other countries *(3)*, with consumer acceptance often described as a large barrier for adoption *(6, 22)*. Overall, we identified barriers and facilitators for purchasing irradiated foods generally and for ground beef specifically. General barriers included general safety concerns about irradiation, a lack of familiarity with irradiated foods, the perception that irradiation is unnecessary, a general distrust of food technology, higher

price, and chub packaging (for ground beef specifically). Facilitators included lower price, general protection from foodborne illness, reduced risk from certain foods, support from public health agencies, positive anecdotes and evidence demonstrating safety and benefits of irradiated foods, and familiar tray packaging (for ground beef specifically). The results from these focus groups provided insight into consumers' knowledge, awareness, and practices toward irradiation as a food safety technology.

Consumer knowledge and awareness

Participants in these focus groups were generally unaware of what irradiation is and how it is used, which is consistent with past research *(6, 14)*. However, education on what food irradiation is and its benefits can lead to significant increases in consumer acceptance by improving consumer knowledge and awareness *(1, 4, 12, 15)*. Two specific studies have demonstrated significant increases in consumer acceptance of irradiated food after educational interventions. A shopping study conducted in 1993 found that the proportion of consumers choosing irradiated over nonirradiated ground beef when there was no price difference rose from 52% to 71% after viewing a short audiovisual educational program *(1)*. Another study showed that consumer acceptance of irradiated food could be increased up to 99% when information about irradiated foods was provided with food samples *(2)*. Such research suggests that educational campaigns could help increase consumer acceptance of irradiated foods.

Facilitators for purchasing

Facilitators for purchasing irradiated foods identified during these focus groups included general protection from foodborne illness, reduced risk of foodborne illness for certain foods, and support from public health agencies. Participants discussed how "peace of mind" from foodborne illness, especially for certain foods such as ground meats and leafy greens that are consumed raw, could be a reason they would purchase irradiated products. This suggests that education around the primary benefit of irradiation—pathogen reduction—could help create a market for irradiated foods for consumers who prioritize food safety. This could include consumers who are at higher risk for severe foodborne illness, such as older adults, women who are pregnant, and children aged 0–5 years *(8)*; those who are concerned about and eat foods frequently linked to outbreaks; and consumers who prefer to eat foods like ground beef undercooked or raw. Dialogue on irradiation among food safety professionals has suggested that discussion about the technology should shift from focusing on possible risks of irradiation to focusing on protecting against foodborne illness *(11, 16)*. With multistate foodborne outbreaks on the rise *(24)*, increasing public discourse about ways to reduce risk of foodborne illness could help educate consumers about how foods can become contaminated, improve consumers' knowledge of types of interventions to improve food safety, and increase consumer demand for irradiated foods. Focus group participants stated that support from public health agencies could encourage consumers to purchase irradiated foods. Multiple public health agencies, including the CDC, WHO, FDA, and USDA, have endorsed the safety and use of food irradiation *(34)*, although there has not been a recent concentrated effort to increase knowledge about irradiation in the United States. This project suggests that these agencies may play a key role in facilitating consumer purchasing decisions when considering irradiated foods for purchase.

Barriers for purchasing

Aside from a lack of knowledge and general safety concerns about irradiation identified among focus group participants, product price, packaging, and a general distrust of food technology were identified as potential barriers when deciding to purchase irradiated foods. Price has been well documented as a primary factor of influence when purchasing food in a store *(19)*. This is important because irradiating foods adds an additional processing step, which could increase the cost of production. Although some participants stated they would pay extra for the added food safety benefit, if this cost is passed to the consumer, our findings suggest it is likely that many consumers would choose nonirradiated products.

Like the findings regarding price, findings from these focus groups suggests that packaging of irradiated products could play a role in consumer purchasing decisions. Focus group participants chose polystyrene (e.g., Styrofoam) tray packaging over chub packaging for ground beef, regardless of whether the ground beef was irradiated. Many food processors package their product before it is irradiated to reduce postirradiation contamination. When certain packaging materials are irradiated, the packaging can become impaired, resulting in an insufficient microbial and chemical barrier for transportation and sale. Polystyrene is not included on the list of approved packaging materials for food irradiation *(33)*. Because ground beef is commonly packaged in a polystyrene foam tray and covered with cling film, it may create a barrier for manufacturers who consider irradiating their ground beef or could result in manufacturers irradiating beef packaged in other types of packaging, like chub packaging, which may be less preferable for consumers. Irradiated ground beef isn't widely available, and products that are offered are usually in chub packaging. Additional packaging options for irradiated ground beef and other irradiated products that could both be irradiated and are acceptable to consumers should be developed.

Lastly, a general distrust of food technology was identified as a potential barrier for consumers when deciding whether to purchase irradiated foods. Some participants who expressed this distrust referenced organic foods, suggesting that less food processing is healthier. Under current regulation, ir-

radiated products cannot be labeled organic regardless of how they are produced and grown *(32)*, although whether focus group participants were aware that irradiated foods could not be labeled organic was not explored in this study. Consumers who intentionally seek organic foods may do so from the perspective of absence claims tied to health concerns, such as the absence of pesticides, herbicides, growth hormones, antibiotics, and genetically modified foods *(9)*. The organic food market has grown rapidly *(30)*, and it is possible that if more irradiated foods were to become available in the marketplace, consumers who prioritize the benefits of organic (perceived health claims) over the benefits of irradiated foods (reduction in pathogens) would decide to not purchase irradiated foods. Further exploration of how attitudes toward organic food or other food technology affect decisions to purchase irradiated foods is warranted.

Limitations

We used qualitative methods, which are not intended to yield results that can be generalized to the overall population. The findings reported are only indicative of the knowledge and beliefs of the participants from these focus groups. In addition, these focus groups were conducted virtually during the 2020 coronavirus pandemic. It is likely that the participants may have experienced a heightened awareness of outbreaks or a distrust of government *(25)* during this time, which may have affected the discussion and results.

Public health implications

Irradiation remains an underutilized food safety tool in the United States, despite its potential for significant public health benefit. The findings from these groups helped to revisit consumer acceptance of irradiated foods by identifying key barriers and facilitators for purchasing irradiated products. Consumer acceptance is often cited as a significant hurdle in wider adoption, yet the results from these groups, along with past research in this area, suggest that some consumers are willing to purchase irradiated foods, some additional consumers may be interested in purchasing irradiated foods once they learn more about it, and consumers may be particularly interested in irradiation for foods that have been frequently linked to outbreaks (e.g., leafy greens and ground beef). A collaborative effort among public and private organizations to increase both knowledge about the benefits of and access to irradiated food could greatly affect consumer acceptance and purchasing of irradiated food within the current market.

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