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Impact of a Community-Based Extension Boiling-Water-Bath Canning Workshop in Maryland from 2018–2024

ABSTRACT

Home canning is associated with family recipes, untested for safety, as an adequate means to prevent foodborne illness. Community-based education by trained Extension agents can build behaviors among home canners to safely preserve food. The research aimed to determine whether consumers increased their knowledge and behaviors related to canning and the effectiveness of agent training in delivering food preservation programs. The University of Maryland Extension, Family & Consumer Sciences agents teach hands-on skills for safely using canning equipment. The program evaluation consisted of a pre-, post-, and 6-month follow-up survey guided by the Theory of Planned Behavior about their food preservation practices. Matched surveys were completed by 324 participants (2018–2024), where no data was collected from 2020–2021 (COVID-19). The majority of respondents were female (82.7%), white (81.8%), and about half received a college degree or higher. Match-paired *t*-tests indicated a significant increase ($p < 0.05$) in respondents' confidence from pre to post-surveying operating a boiling-

water bath canner, canning for others, using laboratory-tested recipes, and contacting Extension agents about food preservation compared to the start of the 3-hour workshop. Extension agents can play a positive role in creating a safe food supply.

INTRODUCTION

The technique of “canning” for food preservation originated in the early 1800s with Nicolas Appert’s innovation of using heat with an airtight seal to preserve food in jars without refrigeration (38). A hundred years later in the United States (U.S.), tomato clubs in the South were gaining popularity, especially among girls learning the modern science and technology of canning (11). Home canning continued to progress as a household necessity during the Great Depression and was at its height in 1943, during World War II (38). Post World War II, canning waned as women reduced domestic duties at home and remained part of the employed workforce alongside men. This provided an opportunity to expand the food landscape with emerging technologies and how families were purveying food with the

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advent of microwaves, home refrigeration, and frozen meals (38, 41). The U.S. saw an increase in canning popularity in the 1970s as part of the “Do-It-Yourself Movement” (38, 44) and during the COVID-19 pandemic (32). Home canning offers consumers the advantage of improving their household nutrition, reducing food waste, and reducing food insecurity by stocking their pantries with nutritious foods. In Maryland during the COVID-19 pandemic, an informal statewide needs assessment (N=4,288) by the University of Maryland Extension (UME), Family & Consumer Sciences agents (FCS) identified workshops around food preservation, food safety, food access and food security, and reducing food waste at home as education information needed.

The availability of home canned produce enhances the food environment, enabling home canners to increase their consumption of fruits and vegetables (2). In addition, when the canning process is performed safely, it destroys harmful microorganisms, such as *Clostridium botulinum* (botulism), a health hazard. Botulism is a rare neurotoxic disease that can cause paralysis of key organs (7). This Gram-positive bacterium produces spores that can survive extreme conditions including the temperature of boiling water (212°F), where the bacterium can subsequently produce the odorless, tasteless, and unseen neurotoxin in an environment with low to no oxygen, low acid pH above 4.6, within the right range of moisture and temperature (8). Another variable is whether home canners follow food safety guidelines to prevent risks of *C. botulinum* spore survival. It was not until 1917 that the United States Department of Agriculture (USDA) recommended pressure canning as the only way to safely process low-acid foods (38). The U.S. Department of Agriculture developed more complete consumer guidelines in 1988, with the *Complete Guide to Home Canning* (38) and the National Center for Home Food Preservation in the 2000s (29). In a study by Odlaug and Pflung (1978), looking at commercial and home-canned high-acid foods from 1899–1975, outbreaks of foodborne botulism from home-canned foods totaled 34 outbreaks, whereas commercially canned foods during the same time frame totaled one outbreak (33). Low-acid canned foods from 1899–1975 were attributed to 485 home-canned outbreaks of foodborne botulism, whereas commercially processed canned foods during the same time frame totaled 64 outbreaks (33). Odlaug and Pflung (1978) highlight a difference between processing high- and low-acid foods in a home environment versus a commercial environment (33). However, botulism can be a unique risk to high-acid foods due to apple variety (20), vinegar acidity percentage when pickling (40), and inadequate heat penetration due to tomato skins that are not removed (30). Communication and education around agricultural and industrial updates are needed to help home canners make informed decisions to prevent outbreaks related to high and low-acid home-canned foods.

Foodborne botulism occurs when a person consumes the toxin in contaminated food (7). Home-canned foods are associated with *Clostridium botulinum* or botulism (8, 33). From 1998–2023, the Centers for Disease Control and Prevention, Bacteria, Enterics, Ameba, and Mycotics Dashboard for foodborne *Clostridium botulinum* reported 77 outbreaks, 276 illnesses, 220 hospitalizations, and 18 deaths, where 12 confirmed cases of “home canned” were identified (6, 43). *Clostridium botulinum* has a significant economic impact. In 2023, the per-case cost mean for botulism was \$2,101,818, with annual estimates of 55 acute illnesses, 13 physician’s visits, 33 with recovered hospitalizations, and nine deaths (22). In 1914, the Smith-Lever Act helped start what would officially become Home Demonstration agents (38), who were associated with their 1862 Universities (42). Agents would go to their local community to teach safe canning methods based on the latest science and technology (38). Extension agents continue the legacy of educating their local communities. The Grow It, Eat It, Preserve It! (GIEIPI) program created by UME FCS agents, is grounded in science and evidence-based food safety and preservation principles. It teaches participants the “hows” and “whys” of safe food handling as it relates to preserving foods at home. This program is connected to Grow It Eat It (GIEI), a Home & Garden Information Center subprogram that recruits Master Gardener Volunteers (MGVs) to teach science-based home horticulture practices for edible crops. The training for MGVs does not include food preservation; however, they can refer their clients to FCS agents. Other State Extension agents and Master Food Volunteers are engaged in research to bring awareness of unsafe recipes on social media (37), correcting food influencers (18), and providing safety guidance on emerging technologies such as electric pressure canners for low-acid food canning (5, 27).

Program evaluation is beneficial in identifying if a program is successful, its efficacy, ability to meet the learning objectives, identifying areas of improvement, and demonstrating impact (35). Surveys are a valuable tool commonly used in various outreach food safety programs (4, 16). In combination with a standardized tool, theory can help researchers understand their target audience. For instance, the Theory of Planned Behavior (TPB) is a psychological framework that seeks to explain human behavior (1) and is commonly used among consumer food safety education evaluations (13). According to Ajzen (1991), TPB posits that intention, which is influenced by attitudes, subjective norms, and perceived behavioral control, is a strong predictor of actual behavior (1). The TPB serves as an effective framework for understanding how adult learners can enhance their practices in food safety, particularly when considering the role of university Extension programs in community canning workshops.

The purpose of this research is to determine whether community participants increased their knowledge,

behavioral intentions, and confidence to identify and follow science-based information related to boiling water bath canning and identify if training is sufficient for consistent Extension program delivery of in-person and hands-on boiling-water bath canning workshops. Consistency in Extension agent training, program evaluation, and implementation allows for greater impact to meet Marylanders' interest in safe home canning techniques.

METHODS & MATERIALS

Training. In 2018, FCS agents (n=12) participated in a 2-day training for using boiling-water bath and pressure canning. In 2019–2020 (n=1), and 2022–2024 (n=4), FCS agents attended a 1-day 7-hour in-person training for the use of both types of canning. The training was shortened with new agents watching recordings before the hands-on laboratory for time efficiency after 2018. All training was organized and largely implemented by one agent, who holds degrees in nutrition and food science, food microbiology, and completed prior state training in 2014. Until 2021, there were six FCS agents actively teaching canning workshops, and in 2024, there were seven FCS agents actively teaching canning workshops. All FCS agents held a valid ServSafe Managers license demonstrating their competencies related to food safety, allowing for increased flexibility regarding where a workshop is hosted (e.g., senior center or library) to meet any establishment's food safety requirements (some locations and jurisdictions require a valid food safety manager license). After the in-person training, new FCS agents observed an experienced FCS agent, co-taught with them, and then taught independently while the experienced FCS agent observed the new agent before teaching the program. Food safety information relevant to food preservation is shared among FCS agents during annual in person and virtual meetings, where monthly updates are provided in between these meetings.

Recruitment. Canning workshops occurred in Extension offices, community centers, libraries, greenhouses, schools, and other locations where communities congregate across Maryland. Potential workshop participants self-selected themselves to enroll. Workshops were advertised by word of mouth, websites, social media, brochures, flyers, local newspapers, listservs, and newsletters. Institutional Review Board approved our human subject research (#756523) from the University of Maryland College Park, where any person 18 years or older was allowed to participate in our voluntary pre, post, and six-month follow-up evaluations. The cost of attending workshops was reduced from \$35 to \$20 per person unless the UME FCS agent or other groups provided funds to cover the cost of supplies, such as jars, ingredients, and printed materials.

Workshop. The canning workshops follow a similar pattern of: 1) welcoming participants, 2) administering the consent and pre-evaluation, 3) presenting the workshop

content via PowerPoint presentation, 4) optional hands-on activity in the kitchen, transforming raw ingredients into a processed jar, 5) administering the post-evaluation, and 6) allowing participants to voluntarily take their canned product with instructions to immediately refrigerate jars since jars were moved and did not have the appropriate time to create a valid vacuum seal. Modules that include a hands-on activity take approximately 3 hours (water-bath canning) to 4 hours (pressure canning). Trained FCS agents lead workshops.

Processing: Hands-On Activity. Before participants go into the kitchen, FCS agents would 1) clean and sanitize work surfaces and cooking equipment, 2) clean jars (pre-sterilize as needed), 3) set out materials for the activity, 4) review the recipe, and relegate tasks to individuals so there is a clear activity for each participant, and 5) have participants wash their hands.

In the kitchen, FCS agents reinforced key messages shared during the presentation. Simultaneously, participants practiced what they learned in the lecture to process a tested home canning recipe using pressure or boiling-water bath canning methods. Recipes were prepared in small groups to process a canner load of jars. While jars were processing, the FCS agents visited website resources on the National Center for Home Food Preservation (NCHFP) website and videos (28) as well as the Maryland's Best website for finding local produce at farmers' markets and pick-your-own farms, etc. (26).

Powerpoint presentation. The canning curriculum GIEIPI was developed and peer-reviewed in 2013 (EC-03-2013). In 2015, 2018, and 2023 the GIEIPI curriculum was revised to include updated information and modifications to the Jams, Jelly, & Butters, Pickled Products, High-Acid Foods, Low-Acid Foods, and Tomatoes curriculum. All curriculum slide decks were rebranded, reorganized, and additional slides and graphics were included to clarify sanitizing and the role of a process authority for family recipes (Figure). Curriculums were redesigned for learning the basic steps and safety principles of home canning, called "the common core." The presentations then touch on nuances of that topic, for instance, reviewing vinegar acidity during pickling and reviewing the different types of pectin during jams, jellies, & butters.

Survey design. Before 2015, a retrospective evaluation was given to participants. Upon review, the survey was redesigned as a pre-, post-, and six-month follow-up evaluation. The Theory of Planned Behavior (TPB) guided the outline of several survey questions around subjective norms, intent, and self-efficacy (1). The subjective norm focused on using family recipes since canning often has family roots (25), participants' confidence to operate a water bath canner, and their intent to use laboratory-tested recipes from reputable sources were measured. The participants' intent to use Maryland's Extension for future preservation questions was also asked. Both the pre- and post-surveys would fit the front

and back printing on an 8.5" x 11" piece of paper, making it less burdensome for the participants to complete. The survey also included multiple-choice questions, a short response for an email address to voluntarily participate in the follow-up evaluation, and a four-point Likert scale. The benefit of using a four-point Likert scale is it removes the neutral responses that do not add value to the data set (3) or create a simple dichotomy. Each evaluation has 10 (pre), 12 (post), and 9 (follow-up) questions, and it took under 10 minutes to complete each evaluation. The survey was reviewed by two evaluation specialists for face validity (36) and was piloted by two agents in 2016 and 2017, and adjustments were made to be used statewide in 2018–Present (19).

Data analysis. Raw data were entered in Qualtrics (Qualtrics, Provo, UT), the online survey platform for descriptive analysis. A 4-point Likert scale was not collapsed, where missing data or responses of “N/A” were not used in the t-test analysis. The percent change for unmatched pairs for the knowledge item was conducted using Microsoft Excel 365, and frequencies were conducted with Qualtrics Stat iQ.

RESULTS

A total of 324 matched individuals participated in the pre- and post-program evaluations between 2018 and 2024 (Table 1). Respondents represented 14 out of 24 counties in Maryland, including Baltimore City. The majority of respondents (62.9%, $n = 202$) reported not preserving food at home in the past six months, and 83.4% ($n = 267$) indicated they had not taken another food preservation workshop (Table 3). The majority of respondents identified as female (82.7%, $n = 249$), non-Hispanic (96.3%, $n = 285$), and white (81.8%, $n = 247$). Additionally, 65.7% ($n = 199$) held a college degree or higher (Table 1). Many respondents reported a household annual income of \$75,000 or more (39.9%, $n = 120$) and were between the ages of 25–34 years (21.1%, $n = 64$) and 55–64 years (23.4%, $n = 71$) (Table 1).

No program data were collected in 2020 or 2021 due to food handling and group events/meeting restrictions imposed by COVID-19 pandemic, where in-person programming was restricted or limited. Results represent only the boiling-water bath canning responses due to the limited pressure canning data response rate ($n < 40$). Similarly, the six-month follow-ups are not reported due to a low response rate (under 4% each year).

One knowledge-based survey question asked respondents what foods should be pressure canned, with the correct response being “vegetables, meat.” Incorrect responses included “jams & jellies” and “pickled products.” Correct responses increased by 20.0% from pre-evaluation (55.5%) to post-evaluation (75.5%).

Regarding the intent to use reputable sources for food preservation recipes—such as the USDA Complete Guide to Home Canning, the National Center for Home Food Preservation—*So Easy to Preserve*, and *Ball’s Blue Book*—a

statistically significant increase was observed in respondents’ likelihood of using these resources (Table 2). Conversely, the use of family recipes, which are not scientifically validated, decreased significantly. Respondents demonstrated a significant shift in social norms, with more individuals indicating they would “never” use family recipes (Table 2).

Respondent’s pre and post-evaluations were matched for t-test analysis to assess respondents’ confidence in using a boiling-water bath canner. Another survey question evaluated respondents’ confidence in safely preserving foods for themselves and others. Both items demonstrated statistically significant improvement from pre- to post-evaluation ($p < .0001$, Table 2). Finally, to assess behavior change, respondents were asked about their likelihood of seeking guidance from the University Extension for future canning-related questions. A statistically significant improvement in this behavior was observed from pre- to post-evaluation ($p < .0001$, Table 2). Our community-based study demonstrates Maryland Extension’s FCS agent training protocol has enabled consistent in-person delivery of boiling-water bath canning statewide. The in-person hands-on workshop significantly improved program participants’ knowledge, behavioral intentions, and confidence to identify and follow science-based information related to boiling water bath canning. Through the collection of pre and post-data, respondents showed a significant increase in confidence to operate a boiling-water bath canner and preserve foods for others.

DISCUSSION

There were no statistical differences in respondents’ demographics before (2018–2019) and after COVID-19 (2022–2024). FCS agents’ recruiting participants is consistent before and after COVID-19 but should be reassessed to draw more diverse communities to Extension programs. A 2023 national needs assessment survey on seafood canning interests mirrored similar demographic trends (24) as the current study. Extension agents who teach canning-preservation workshops should continue to explore new ways to engage new audiences with canning workshops. There is still a need to reach Maryland residents in 41.7% of the state counties who did not participate in a canning workshop from 2018–2024. These data support the idea that key community groups are either being missed through traditional Extension marketing channels or that different food cultures rely on other preservation methods besides canning (34). Highland (2024) stated younger people were not as interested in canning (21), but our study did not identify one age range as being more significant, where age ranges were not heavily skewed. To our knowledge, this is the first food preservation study to observe the demographics of a statewide home canning program before and after COVID-19. Other educational groups have evaluated preservation programs pre-COVID (16) or post-COVID

TABLE 1. Respondent demographics, where no workshops occurred in 2020–2021

Demographic characteristic	Total n (%)	2018 n (%)	2019 n (%)	2022 n (%)	2023 n (%)	2024 n (%)
Gender	301 (100)	73 (24.3)	58 (19.3)	49 (16.3)	75 (24.9)	46 (15.3)
Female	249 (82.7)	52 (17.3)	50 (16.6)	42 (14.0)	66 (21.9)	39 (13.0)
Male	52 (17.3)	21 (7.0)	8 (2.7)	7 (2.3)	9 (3.0)	7 (2.3)
Hispanic/Latino	296 (100)	73 (24.7)	55 (18.6)	49 (16.6)	73 (24.7)	46 (15.5)
Yes	11 (3.7)	1 (0.3)	2 (0.7)	1 (0.3)	2 (1.7)	5 (1.7)
No	285 (96.3)	72 (24.3)	53 (17.9)	48 (16.2)	71 (24.0)	41 (13.9)
Race	302 (100)	73 (24.2)	57 (18.9)	49 (16.2)	75 (24.8)	48 (15.9)
American Indian or Alaska Native	2 (0.7)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0)
Asian	4 (1.3)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.3)
Black or African American	38 (12.6)	10 (3.3)	7 (2.3)	0 (0.0)	10 (2.3)	11 (3.3)
Native Hawaiian or Other Pacific Islander	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
White/Caucasian	247 (81.8)	31 (10.3)	62 (20.5)	47 (15.6)	62 (16.2)	31 (19.2)
Two or more races	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Some Other Race	5 (1.7)	1 (0.3)	0 (0)	0 (0)	0 (0)	1 (1.0)
Prefer not to answer	6 (2.0)	2 (0.7)	1 (0.3)	1 (0.3)	1 (0.3)	1 (0.3)
Education	303 (100)	73 (24.1)	57 (18.8)	50 (16.5)	75 (24.8)	48 (15.8)
Less than high school	6 (2.0)	0 (0.0)	2 (0.7)	0 (0.0)	3 (1.0)	1 (0.3)
High school graduate	28 (9.2)	7 (2.3)	9 (3.0)	1 (0.3)	6 (2.0)	5 (1.7)
Some college	70 (23.1)	13 (4.3)	17 (5.6)	10 (3.3)	17 (5.6)	13 (4.3)
College graduate	116 (38.3)	31 (10.2)	21 (6.9)	20 (6.6)	29 (9.6)	15 (5.0)
Graduate degree	83 (27.4)	22 (7.3)	8 (2.6)	19 (6.3)	20 (6.6)	14 (4.6)
Age	304 (100)	73 (24.0)	58 (19.1)	50 (16.4)	75 (24.7)	48 (15.8)
<25	18 (5.9)	9 (3.0)	1 (0.3)	3 (1.0)	3 (1.0)	2 (0.7)
25–34	64 (21.1)	25 (8.2)	9 (3.0)	6 (2.0)	16 (5.3)	8 (2.6)
35–44	29 (9.5)	8 (2.6)	6 (2.0)	4 (1.3)	7 (2.3)	4 (1.3)
45–54	49 (16.1)	11 (3.6)	9 (3.0)	9 (3.0)	11 (3.6)	9 (3.0)
55–64	71 (23.4)	12 (3.9)	15 (4.9)	20 (6.6)	14 (4.6)	10 (3.3)
65–74	54 (17.8)	8 (2.6)	13 (4.3)	7 (2.3)	17 (5.6)	9 (3.0)
75+	15 (4.9)	0 (0)	4 (1.3)	1 (0.3)	5 (1.6)	5 (1.6)
Prefer not to answer	4 (1.3)	0 (0)	1 (0.3)	0 (0)	2 (0.7)	1 (0.7)
Household income	301 (100)	73 (24.3)	57 (18.9)	49 (16.3)	75 (24.9)	47 (15.6)
<\$15,000	6 (2.0)	1 (0.3)	1 (0.3)	1 (0.3)	3 (1.0)	0 (0.0)
\$15,001–\$24,999	16 (5.3)	5 (1.7)	6 (1.7)	0 (0.0)	4 (1.3)	1 (0.3)
\$25,000–\$49,999	51 (16.9)	17 (5.6)	7 (5.6)	5 (1.7)	16 (5.3)	6 (2.0)
\$50,000–\$74,999	55 (18.3)	13 (4.3)	10 (4.3)	11 (3.7)	11 (3.7)	10 (3.3)
\$75,000+	120 (39.9)	28 (9.3)	23 (9.3)	24 (8.0)	21 (7.0)	24 (8.0)
Prefer not to answer	53 (17.6)	9 (3.0)	10 (3.3)	8 (2.7)	20 (6.6)	6 (2.0)

TABLE 2. Paired *t*-test of Pre-and Post-test scores on individual test questions (2018–2024), on a Likert scale of 1 to 4a where no workshops occurred in 2020–2021

Question	Pre-test		Post-test		N	Cohen's d	<i>t</i>	df	<i>p</i> -value
	M	SD	M	SD					
I am confident in my ability to safely operate a water bath canner	2.91	1.09	3.71	0.60	262	0.73	-11.92	261	<0.0001
I am confident to safely preserve foods for myself and others	2.78	1.10	3.61	0.68	269	0.76	-11.30	268	<0.0001
It is expected of me that I use family recipes	1.68	0.96	1.79	1.08	241	0.12	-1.57	240	0.01
I intend to use current laboratory-test recipes from USDA Complete Guide to Home Canning, National Center for Home Food Preservation- <i>So Easy to Preserve</i> , and <i>Balls Blue Book</i>	2.28	1.33	3.82	0.49	217	1.53	-17.23	216	<0.0001
I intend to contact my University of Maryland Extension educator if I have questions about food preservation	1.96	1.28	3.71	0.60	216	1.74	-19.92	215	<0.0001

TABLE 3. Respondent's current canning activity, where no workshops occurred in 2020–2021

Preservation Activity	Total n (%)	2018 n (%)	2019 n (%)	2022 n (%)	2023 n (%)	2024 n (%)
In the past 6-months have you preserved food at home?	321 (100)	73 (22.7)	57 (17.8)	52 (16.2)	77 (24.0)	62 (19.3)
0 Times	202 (62.9)	41 (12.8)	35 (10.9)	35 (10.9)	50 (15.6)	41 (12.8)
1–2 times	68 (21.2)	21 (6.5)	10 (3.1)	13 (4.0)	15 (4.7)	9 (2.8)
3–5 times	29 (9.0)	8 (2.5)	6 (1.9)	2 (0.6)	6 (1.9)	7 (2.2)
6+ times	22 (6.9)	3 (0.9)	6 (1.9)	2 (0.6)	6 (1.9)	5 (1.6)
Have you attended a different home food preservation workshop besides UME?	320 (100)	73 (22.8)	57 (17.8)	52 (16.3)	77 (24.1)	61 (19.1)
No	267 (83.4)	63 (19.7)	49 (15.3)	44 (13.8)	60 (18.8)	51 (15.9)
Yes	53 (16.6)	10 (3.1)	8 (2.5)	8 (2.5)	17 (5.3)	10 (3.1)

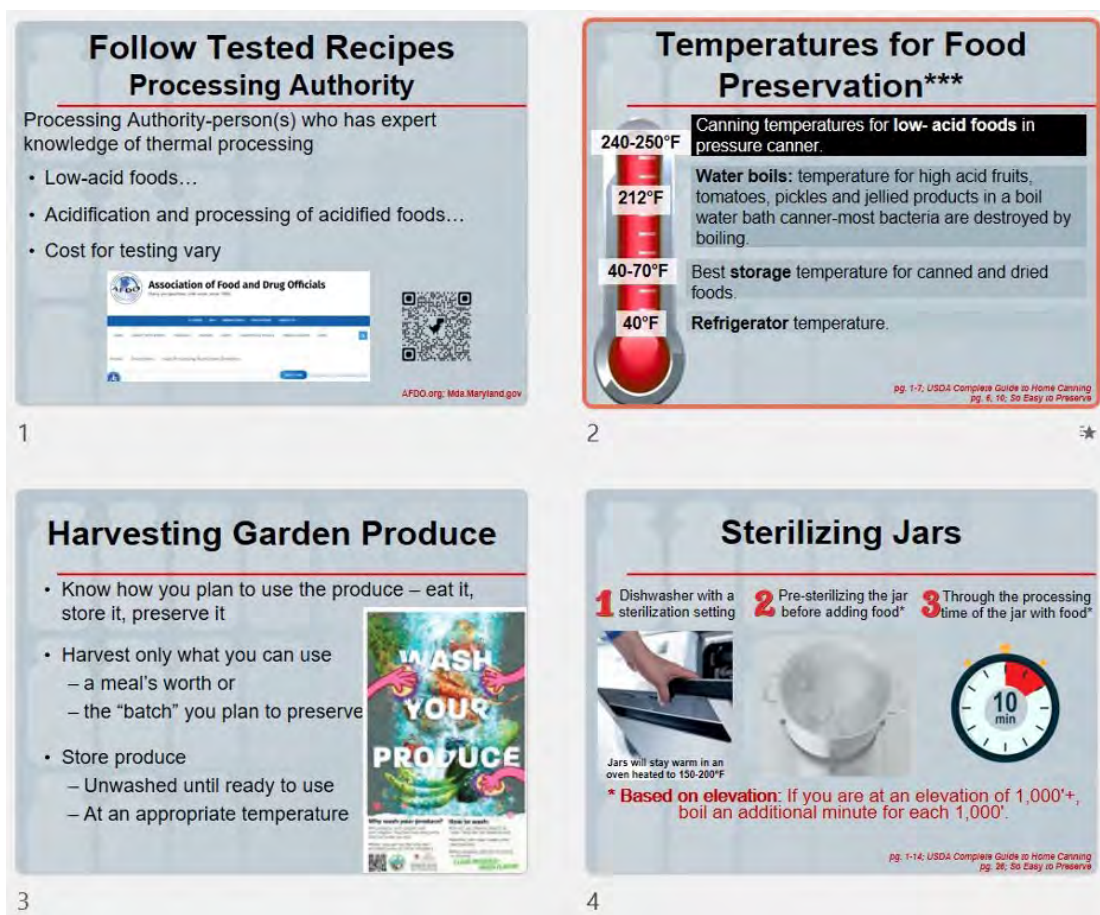


Figure. Some of the common core slides created and/or modified since 2015.

(2), where the evaluations were retrospective (16) and how agents taught the program were not always hands-on or focused on canning, and demographic information was not collected (16). For example, Garden-Robinson et al. (2019) may have subtle differences between demographic indicators or if their evaluation tool analyzed the difference between preservation programs for freezing, drying, or not hands-on preservation workshops. Other Extension programs have used a hybrid method (15), but this time-saving method demonstrates participant attrition between the online and in-person workshops (15), where key behavior reinforcement may be missed by participants who are not in attendance for the in-person workshop. Community-based education is beneficial, regardless of the intervention delivery.

Unlike our six-month follow-up evaluation, where the response rate was under 4%, Garden-Robinson et al. (2019) had a 12.4% (16), while Beavers et al. (2023) (48.4%) were able to offer \$15 compensation for completing the follow up (2). Where our follow-up invitation occurs at least six months after the program, Garden-Robinson et al. (2019) were three to six months (16), while Beavers et al. (2023) implemented two to three months post-workshop

(2). To determine long-term statewide impact, exploring compensation or other strategies, such as a compressed time between initial training and follow-up, should be investigated.

Knowledge does not necessarily lead to behavior change (45), so one knowledge item was asked regarding what foods should be pressure-canned. Participants identifying vegetables and meat can help them move to using a pressure canner to reduce their risk of botulism (8). Awareness of a process authority was added and updated in the common core slide deck (2019) because FCS agents were continually being asked about family recipes. Our modification encourages participants to work with a process authority to validate family recipes or develop new recipes. A process authority has the expertise and resources to determine the safety of a food or recipe (12), so teaching about a process authority provides a potential solution (e.g., cultural foods) rather than dismissing participants by saying, "no, you cannot use this family recipe." Locating a process authority and cost could be a potential barrier. Still, in our workshops, we share the Association of Food and Drug Officials "Food Processing Authorities Directory" as a resource with their permission (Figure).

Our study found that hands-on experience and practice

through a community-based canning course increases safe food preservation behavioral intentions, confidence, and knowledge. Participants receive the information they need to understand food safety protocol, engage with the material, and apply theoretical knowledge in real-time. This process reinforces knowledge gained by providing immediate feedback and correcting mistakes while reinforcing good practices. By evaluating canning workshops framed by the Theory of Planned Behavior, our Extension program can effectively support adult learners in adopting and promoting food safety behaviors. When participants recognize the benefits of safe canning, they are more likely to engage in these behaviors and eat more produce (2). The influence of peers and community members on a participant's canning behaviors makes for the social norms that are relevant to the standardized evaluation.

While our findings provide valuable insights, several limitations should be considered while reviewing the results. The pandemic disrupted data collection due to the hands-on approach to this course. Though home food preservation interest spiked during the pandemic (29), our study was paused due to the inability to hold workshops or collect data during lockdown and limited face-to-face programs in 2021. The increased interest in home food preservation necessitates community food safety education. Globally, the most common cause of foodborne botulism occurred in the United States through noncommercial home-canned foods (14). Research indicates during COVID-19, disseminating food safety concepts among the public was important (25). As noted by Gurudasani & Sheth (2009), efforts should be made to educate consumers about the relationship between food and diseases and the importance of making proper food choices (17). Improper canning practices negatively impact the health and mental wellness of those households that experience foodborne botulism (39). Extension programs have a role in helping adult learners appreciate the benefits

of safe food handling through such experiential learning opportunities.

CONCLUSION

The research supports consumers increased their knowledge and behaviors related to canning and the effectiveness of agent training in delivering food preservation programs. University Extension programs can effectively support adult learners in adopting and promoting food safety behaviors. This benefits the individuals involved and fosters a healthier community ethos, emphasizing the importance of food safety in everyday life. University Extension programs also play an essential role in shaping positive attitudes toward safe canning practices. Extension provides educational workshops and resources highlighting the health benefits of proper canning techniques and the risks associated with unsafe methods. Extension oriented researchers can also assist by developing additional validated recipes for popular nontraditional or family recipes that are as yet unvalidated; for example, the National Center for Home Food Preservation has a "Recipe Interest Form" (28). These programs can foster a safer and more favorable view of canning by offering evidence-based information and demonstrating the advantages of canning, such as preserving seasonal produce and reducing food waste. Implementing a simple and effective standardized evaluation tool based on theory to capture key information that illustrates our success to the university and invested stakeholders.

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