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Evaluation and Impact of Food Safety Messages in New Media for Trending Recipes: Savory Jam on YouTube

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EVALUATION AND IMPACT OF FOOD SAFETY MESSAGES IN NEW MEDIA FOR TRENDING RECIPES: SAVORY JAM ON YOUTUBE

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An Abstract of the Thesis Presented
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Home canning has been used as a method of food preservation for hundreds of years. The United States has a regulatory agency known as the National Center for Home Food Preservation (NCHFP), which gives guidelines on canning safely to decrease the risk of foodborne illness. The NCHFP provides tips for fruit jams and jellies; however, savory jam is rising in popularity. Savory jam includes jams with a savory main ingredient, such as tomatoes, bacon, onion, or chili peppers. There are currently no guidelines for safe preparation of savory jams. Research is needed to see if recipes for savory jam are safe, particularly in the YouTube space, as the quality of food safety messaging on this platform has not been investigated. YouTube allows creators with a variety of expertise levels in food and safety to upload recipes for home canners. Analysis of safety messages in these cooking videos will help determine the level of risk associated with this emerging platform.

Additionally, a survey was conducted to assess whether home canners are following the same "safe" and "unsafe" practices observed in YouTube videos. Finally, home canners followed a YouTube video to prepare jam. The jam then underwent physical, chemical, and microbial analysis to assess its suitability for safe water bath canning.

In the evaluation of YouTube savory jam recipe videos we found that the expertise level of the content creator significantly impacted the quality and prevalence of food safety messages. Amateur creators received lower scores than those of expert level creators. Recipes for canned jams (as opposed to those stored under refrigeration) demonstrated a higher percentage of correct guidance, however, these videos still failed to include all the necessary information for safe canning. This analysis demonstrated that there is continued research and education needed for both producers and consumers of such content to keep home canners safe. When savory jam was made according to the instructions of amateur level videos found on YouTube, pH was the only factor analyzed for which all samples met the current recommendation for fruit-based jams of 4.6 and below. Both Brix and water activity had values below recommended levels which created a product that is potentially unsuitable for water bath canning. Using this method of processing for such a recipe could contribute to increased risk of illness and spoilage. When home canner habits were surveyed it revealed that older participants in the survey were more likely to follow safe standard procedures for canning. However, this is concerning for newer home canners that are of younger age who are less likely to follow these procedures to keep them safe. As newer forms of recipe sourcing rise, and recipes we've never seen before become trending, this interaction of food and safety needs to be further explored to ensure safety at home. The responsibility to create safe content and affect dissemination of information lies on the governing bodies, the content creator, and the viewer to consider these safety considerations when using new media forms.

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LITERATURE REVIEW

1.1 Introduction

For over 200 years, canning, first invented by Nicolas Appert in 1809, has been a safe and accessible method of food preservation (Barksdale, 2018; United States Department of Agriculture National Agricultural Library, n.d.; National Canners Association, 1959; Anonymous, n.d.). The popularity of canning follows a trend of increasing during wartime and economic hardship to decrease the financial burden of buying food (National Canners Association, 1959; New York Daily News, 2008; Andress, 2019). In recent years, the increase in the availability of both local ingredients and new food items at the supermarket has led home canners to get creative in the kitchen (Goard et al., 2013; Gupta, 2016; Azcentral, 2014). Tastemakers are increasingly experimenting with varieties of jam that combine sweet and salty flavors: savory jam. This new variation, however, currently has no validated recipes like those available for standard fruit-based jam from both the National Center for Home Food Preservation and the FDA (Food and Drug Administration) and USDA (United States Department of Agriculture). As this new form of jam is increasing in popularity, so are new media platforms, such as YouTube and blogs, from which we gather our recipes. In addition to uncertainty about the safety of canned savory jam recipes, the ways in which food safety is portrayed (or not) through these new platforms is not well understood. This literature review addresses the potential food safety hazards influenced by new media platforms as well as the potential food safety risks associated with savory jam.

1.2 History of Canning

Modern jam and jelly production methods are believed to have originated from preservation methods first implemented in ancient Greece, where honey was combined with fruit

(Nummer, 2002). Today, jam is prepared by boiling a fruit mixture, then utilizing a water bath or pressure canning to process, or seal, this sugar and fruit mixture into jars (Merriam-Webster, n.d.). This processing approach was first introduced in France when the French Directory (five members in executive power including Napoleon Bonaparte) funded a national competition to develop a novel food preservation method to extend the shelf life of products used in military rations (Barksdale, 2018; HISTORY, 2009; United States Department of Agriculture National Agricultural Library, n.d.; National Canners Association, 1959). In 1809, Nicolas Appert won the prize for his innovative vacuum sealing technique to preserve cheese and limes in champagne bottles (Barksdale, 2018; United States Department of Agriculture National Agricultural Library, n.d.; National Canners Association, 1959; Anonymous, n.d.). In 1817, Americans adopted this practice and began to use tin canisters, then cans, as opposed to glass containers to store food, which gave rise to modern canning (National Canners Association, 1959). In 1858, the Mason jar was introduced by John Landis Mason. This was a clear glass container that allowed the canner to view the filling to see if it was spoiled (Thomson, 2016; Anonymous, n.d.; National Canners Association, 1959).

Additionally, the jar featured a two-piece top that ensured adequate oxygen exclusion using a rubber material inside the lid (Thomson, 2016; Anonymous, n.d.; National Canners Association, 1959). This new technology increased canned food production by six times to 30 million cans through the mid-1800s (Riggs, 2015). Following the patent of the Mason jar, Ball jars were introduced, eventually becoming the most widely known branded canning material among home canners (Anonymous, n.d.). Canned goods products reached nearly 20 billion dollars in sales in 2012 (Riggs, 2015).

1.2.1 Canning During Wartime

History has demonstrated a definite increase in home canning during times of economic hardship or war (National Canners Association, 1959; New York Daily News, 2008; Andress, 2019). In America, the popularity of home canning surged during World War I. Victory gardens, for example, were a federally proposed program that strongly encouraged American home canners to retain a portion of production to support military efforts abroad (Schumm, 2018; Click & Ridberg, 2010). Households were encouraged to plant gardens based upon the crops that would later be canned in support of this movement. In addition to boosting morale among American citizens, this program also offered a cheaper way to feed the troops on home soil. Children who helped out the cause became referred to as "soldiers of the soil" (Schumm, 2018; National Canners Association, 1959; Spring, 2017). The efforts of these victory gardeners during World War I generated nearly 1.5 million quarts of canned food (Schumm, 2018). This program experienced a resurgence during World War II, when close to 4 billion cans were produced, with participation viewed as an act of national patriotism (Spring, 2017).

1.2.2 Canning During Economic Hardship

More recently, the Great Recession in 2007 resulted in an increase in home canning in the United States (Torpey, 2009) with a reported 30% rise in Ball and Kerr canning product sales during the first year of the 2007 economic recession (Torpey, 2009; Campoy, 2009). Specifically, the reduced cost of producing food at home, as well as the ability to control factors such as locality and nutritional aspects including sugar, and salt levels, are believed to have contributed to this growth (New York Daily News, 2008; Azcentral, 2014).

1.2.3 Canning During Pandemic

Currently, the COVID-19 pandemic has once again precipitated a shift in food consumption and preparation practices. Consumers are coping with social distancing and limited public outings by panic-buying, stocking up on canned foods, and learning about home canning & gardening (Atkinson, 2020; Chan, 2020; Sasso, 2020; Turner, 2020). With an unforeseen end-date of current safety precautions, consumers stock up on canned products in the case that national shortages of food occur (Chan, 2020; Sternlicht, 2020). Shortages are likely to occur if outbreaks occur at processing facilities, such as those associated with poultry processing plants, or temporarily due to panic buying (Sternlicht, 2020). To keep up with the demand, companies like Campbell Soup have increased production (D'Innocenzio, 2020). Grocery stores have also limited the number of individual products, such as toilet paper and eggs, that customers are allowed to purchase in a single transaction to reduce hoarding (Repko, 2020).

To cope with recommended infrequent visits to the grocery store and possible food shortages, those at home are learning about home canning and gardening (Atkinson, 2020; Yu, 2020). George Ball, an owner of Burpee seed company, states that he has not seen as dramatic an increase in seed buying during his career, but that it does show similarities to spikes in his sales seen during challenging economic times (Yu, 2020). Looking back to World War I when Victory Gardens were recommended to end possible food shortages, gardening increased, COVID-19 is following the same trend for consumers who fear these shortages (Turner, 2020; Yu, 2020).

During the week of March 11th, 2020, when the World Health Organization declared COVID-19 a pandemic, there was close to a 30% increase in the purchase of canning and preserving books (Atkinson, 2020; World Health Organization, 2020). This influx in canning and

gardening is likely to cause an increase in the utilization of Cooperative Extension resources due to stay-at-home orders. A recent conversation with the University of Maine Extension Educator, Kathy Savoie, confirmed this theory (Savoie, personal communication, 2020). She has currently (May 2020) received four requests for dial gauge testing for pressure canners, which is usually the amount of activity seen in a year on this subject (Savoie, personal communication, 2020). The reported uptick in contact with Cooperative Extension offices is likely to increase even more as the weather gets warmer (Savoie, personal communication, 2020).

1.3 Safety of Home-Canned Foods

Canned foods can be subdivided into either low-acid or high-acid products. Jam with a pH at or below 4.6 is considered an acid product by FDA (21 C.F.R. § 114, 2019). Traditionally, acidic fruits and the addition of lemon juice help reach this low pH, however, when low acid ingredients are introduced into the formulation, acid can become diluted, which jeopardizes safety (Laborde et al., 2019; USDA & National Institute of Food and Agriculture, 2015). Once jars are sealed, these low-acid additions can foster an environment that facilitates germination and/or reproduction of *Clostridium botulinum* due to a lack of oxygen, increased moisture, and stable storage temperature (Laborde et al., 2019). This anaerobic pathogen is the most common pathogen linked to disease outbreaks caused by home-canned foods. *Clostridium botulinum* is traditionally found in soil that then transfers to the outside of fruit or vegetables (Solomon & Lilly, 2001). The concern with this pathogen is that it can create spores that have the ability to stay dormant until conditions are ideal allowing them to survive for years (FSIS, 2013). Commonly used low-acid ingredients such as onions, peppers, and bacon have become increasingly popular as savory jam becomes more common.

1.3.1 *Clostridium botulinum*

Clostridium botulinum is the pathogen of greatest concern in both traditional jams and savory jam which causes foodborne botulism. Foodborne botulism has a wide distribution of cases throughout the United States (Figure 1.1 & Table 1.1). It is an anaerobic, spore-forming bacterium that is only eliminated during high heat (240-250°F) processing or when introduced to a high acid environment (pH below 4.6) (FSIS, 2013; Solomon & Lilly, 2001). Spore production by the microorganism occurs under conditions that threaten survival. It is a protective mechanism that allows the bacterium to survive for years, and eventually germinate once conditions become favorable (FSIS, 2013). Once in a vegetative state, the pathogen is capable of toxin production, which is a considerable threat to consumer safety. Botulism, an illness attributed to *Clostridium botulinum*, is caused by the ingestion of preformed botulinum toxin. Botulinum toxins (BoNT) are divided into groups I or II, proteolytic, and non-proteolytic, respectively. Four of these neurotoxins commonly cause illness in humans (A, B, E, F), with consumption resulting in an intoxication-derived foodborne illness (World Health Organization, 2018; FSIS, 2013; Spickler, 2018; Collins & East, 1998). Type A, as well as some B and F strains, are proteolytic (Solomon & Lilly, 2001; Lund & Peck, 1994). Alternatively, all E and some B and F strains are non-proteolytic (Solomon & Lilly, 2001; Lund & Peck, 1994). The proteolytic strains are known to have higher heat resistance and require a higher temperature for growth (Lynt et al., 1982; Solomon & Lilly, 2001). The non-proteolytic strains are much harder to control since they have the ability to grow at temperatures as low as 3.3°C and are found most frequently in foods that are kept at refrigeration temperatures (4°C) (Solomon & Lilly, 2001; FDA, 2019; Stringer, 1999). However, the non-proteolytic versions do not activate full toxicity without trypsin (encountered in the stomach after

consumption) and are less heat resistant and normally found in seafood products (FDA, n.d.; Lynt et al., 1982; Solomon & Lilly, 2001).

These neurotoxins are some of the most toxic substances humans can come in contact with (FSIS, 2013; World Health Organization, 2018). This toxin is incredibly serious because it targets nerves in the body, causing symptoms, including progressive paralysis (FSIS, 2013; World Health Organization, 2018). Botulism, the illness caused by ingestion of botulinum toxin, typically has a 5-10% mortality rate, with symptoms occurring as little as 4 hours and up to 36 hours after consumption of the toxin (World Health Organization, 2018). An analysis of botulism cases from 1975-2009 found a higher number of non-infant botulism outbreaks in the final decade, especially seen in older adults, causing a higher overall mortality rate (Jackson et al., 2015)

Figure 1.1: United States Distribution of Foodborne Botulism Cases [A] (2007-2017)[B]

[A] Counts for cases are based by number of individuals affected not by the number of outbreaks that year [B] United States, n.d.; Centers for Disease Control and Prevention (CDC), 2019a; CDC, 2017; CDC, 2017a; CDC,2015; CDC, 2015a, CDC, 2014' CDC 2013; CDC, 2011; CDC, 2011a; CDC, n.d.; CDC, n.d.a

In addition to the previously mentioned risks associated with product formulation and processing of savory jams, the risk for *C. botulinum* presence is also augmented by consumer behaviors. Food Safety News reported that between 1996 and 2008, almost half of botulism outbreaks were derived from home-canned products (Mackin, 2018). Most recently, three outbreaks in 2008 and 2009 in Ohio and Washington State were linked to home-canned foods that were contaminated with botulinum toxin causing twelve intoxications (Date et al., 2011). Those affected by these outbreaks reported engaging in risky consumption behaviors, including overlooking signs of product spoilage, including jars that were not properly sealed and strange taste/smell, which should have discouraged them from consuming the home-canned products that ultimately led to intoxication (Date et al., 2011).

Beyond these obvious safety concerns, there is also considerable economic risk associated with foodborne illness. One outbreak of botulism is estimated to cost 1.4 to 1.7 million dollars per case (Scharff, 2015). Because most consumers do not seek medical treatment for foodborne illness, estimates of prevalence are hard to determine. However, the CDC postulates that 1 in 6 Americans suffer from an illness caused by contaminated food every year (CDC, 2018). The high rate of foodborne illness costs close to $16 billion every year in the United States (CDC, 2018).

Table 1.1: Recent Foodborne Botulism Cases [A]

Case Number	Year	Location	Food Implicated	Number of Intoxications	Botulinum Toxin Type
1	2017	California	Nacho Cheese	10	A
2	2017	California	Herbal Deer Tea	2	A
3	2017	California	Soup	1	A
4	2017	California	Unknown	2	A
5	2017	Alaska	Seal Blubber with Seal Oil	3	E
6	2017	Alaska	Dried Herring in Seal Oil	1	E

[A] CDC, 2019a

1.4 Thermal Processing

The three most common thermal processing methods used during home canning are inversion, pressure, and water bath processing (Table 1.2). Jams are thermally processed to extend shelf life and confer shelf-stability. Canning helps to reduce the probability of spoilage from a variety of factors, including fungi and other microorganisms, oxidation, and moisture loss (NCHFP, n.d.). Home canners achieve this shelf-stable product by heating thoroughly to inactive microorganism and creating a vacuum seal. This vacuum helps to exclude oxygen and

microorganisms from entering the package (NCHFP, n.d.). The seal created from negative pressure is only created when jars are correctly processed, causing contents in the jar to expand and releasing air to decrease the pressure (Anonymous, n.d.a).

Water bath canning is convenient since no additional equipment is needed, only a large pot, and it is an approved method by the National Center for Home Food Preservation (NCHFP, n.d.b). This method is much faster than pressure canning, taking an average of 10 minutes to boil, depending on altitude and jar size (USDA & National Institute of Food and Agriculture, 2015). It is generally assumed that if jars are water bath canned for greater than ten minutes, pre-sterilization of the jars is not needed, which alleviates some fear surrounding proper processing (USDA & National Institute of Food and Agriculture, 2015).

Inversion is when hot jam is filled into a jar, closed with a lid, then placed upside down to seal. This method is not recommended and is known for being the riskiest method for processing (Andress, 2019). Inversion can allow air to penetrate the container opening, providing an access point of oxygen for fungal spore germination and bacterial growth (Andress, 2019). This process not only increases product spoilage rate but presents a potential source of economic loss for home canners (Andress, 2019; McGarry, 2013). The potential of air being let into the jar means that mold spores, for example, have a way to get in the jar, again increasing the likelihood of spoilage (Andress, 2019; McGarry, 2013).

Pressure canning is ideal for processing less acidic products, such as meat and vegetables; however, it can be used for acidic canned products as well. This method has proven to be an effective approach for destroying *Clostridium botulinum* spores as a result of the high-pressure (10-15 PSIG (pounds per square inch of pressure)) and high temperature of 240-250°F (USDA &

National Institute of Food and Agriculture, 2015). However, the downside of pressure canning is a longer processing time compared to the water bath and inversion methodologies, and the need to invest in a pressure canning apparatus. When appropriately executed, pressure canning can take as long as 100 minutes, depending on the type of food being processed, packing procedures, and jar size (USDA & National Institute of Food and Agriculture, 2015).

Both water bath and pressure canning can deter first-time home canners due to the potential risk of foodborne illness if improperly applied. Water bath canning for acid home-canned products is encouraged in the USDA Complete Guide to Home Canning due to the quicker time for processing (USDA & National Institute of Food and Agriculture, 2015). However, in order for water bath canning to be as effective as pressure, a pH of 4.6 or below is required to make sure spores do not germinate, creating BoNT (USDA & National Institute of Food and Agriculture, 2015). When these spores transition to an acidic, moist environment above pH 4.6 (as in improperly acidified jam) and anaerobic conditions (vacuum-sealed jar) they start to multiply, turning into vegetative cells that can quickly replicate, creating toxins in the process (USDA & National Institute of Food and Agriculture, 2015; Albrecht, 2015).

Table 1.2: Home Canning Processing Methods

Mode of Processing	Benefit of Method	Drawbacks of Method	Recommended by NCHFP [D]?
Inversion [A] 	Minimal work needed by home canner. No extra equipment needed for processing.	Weaker vacuum seal allowing the potential of contaminants to enter. Excess oxygen left in the jar allowing possible fungal growth.	No

Table 1.2 Continued			
Water Bath [B] 	Quicker processing (minimum 10 minutes boiling depending on altitude). Effective in destroying *Clostridium botulinum* in acid foods (at or below pH 4.6).	Not recommended for low-acid food. Additional equipment (stock both or water bath canner) needed.	Yes
Pressure Canner [C] 	It can be used both for low-acid and acid foods. Effective in destroying *Clostridium botulinum* in acid foods and low-acid foods.	Take a long time to process (up to 100 minutes). Special equipment is utilized.	Yes

[A] Inversion, 2011; Andress, 2019; Andress, 2003. [B] Water Bath Canning, 2019; USDA & National Institute of Food and Agriculture, 2015. [C] Pressure Canning, 2020; USDA & National Institute of Food and Agriculture, 2015. [D] NCHFP- National Center for Home Food Preservation

1.5 Attitudes Toward Home Canning

New canners often feel intimidated by canning jam due to the precision of the canning process needed to mitigate the well-known risk of botulinum contamination (Clark, 2012; Stiavetti, 2009). To help reduce the fear behind conventional jam processing, refrigerator and freezer jams are an increasingly popular alternative to canned jam and are particularly useful for small batch production. Melissa Clark, a writer for The New York Times, discusses how easy alternative jams

are--no need for sterilization or pectin, alluding that these alternative jams relieve pressure for the home canner (Clark, 2012). This increase in the popularity of refrigerator and freezer jams is evident in the sales growth of containers used for freezer and refrigerator jam production. In 2008, for example, Ball experienced a 30% increase in sales as a result of containers used to make freezer jams (New York Daily News, 2008).

Despite a perceived reduction in botulinum risk because of aerobic conditions, refrigerator/freezer jam processing does not eliminate all hazards associated with traditional water bath processing. These jams can spoil or cause foodborne illness because of potential temperature abuse. Accidental contamination can introduce various microflora that are capable of growth or survival during refrigerated and sometimes even frozen storage (Kendall, 2003). The most notable pathogens, including *Listeria monocytogenes, Campylobacter jejuni, Staphylococcus aureus,* and *Salmonella* have each been reported to survive in food products held at temperatures close to 5°C, or lower in some instances, and although the FDA recommends a 4°C storage temperature, this temperature is often not achieved by home refrigerators (Palumbo, 1986; Treiber, 2016; Kendall, 2003; FDA, 2019). Bloggers and writers alike provide messages that there is little risk to these alternative jams, creating a confident consumer who may not realize the potential foodborne illness risks associated with the mishandling of these products.

A survey on current home canning habits in the U.S. found a noticeable lack of food safety considerations among home canners. Nearly half of the respondents reported using friends or relatives as a primary source for canning information (Andress et al., 2002). Unfortunately, home canners utilize this information at face value, with little consideration for accuracy, thus increasing the risk for foodborne illness. Thirty percent of botulism cases over an eighteen-year period (1996-2014) were linked to home-canned products not following proper guidelines for safe canning

(CDC, 2019). In a 2018 outbreak, a home canner linked to a home-canned botulism outbreak reported making changes to the recipe, such as substituting fresh for frozen peaches (Bergeron et al., 2018). She used a water bath canner, which is not suggested for low acid ingredients, such as peas that she canned. A pressure canner is recommended for this product because it is capable of inactivating *C. botulinum* spores due to the higher temperatures reach in the processing vessel, which in this instance survived the water bath canning process and germinated in the low acid environment of the product (Bergeron et al., 2018).

1.6 Rise of Savory Jam

Americans are notorious around the world for a diet high in salt, sugar, and fat. Specifically, the average American consumes over 70 kg/yr of sugar (Rao et al., 2018). Processed foods are regularly consumed due to their low cost, convenience, and 'crave-able' taste, keeping consumers coming back time and time again (Rao et al., 2018). This concept has led to home canners experimenting in jam formulations that incorporate additional sugar, salt, and fat characteristics of those 'crave-able' foods into homemade jam. Jams are routinely a high-acid food, containing fruit and an acidulant, typically vinegar or lemon juice; however, savory jam blurs the acid lines. *C. botulinum* is the primary safety concern associated with home canning. Eliminating fruit or lowering acidity in a jam can increase the ability of botulinum spores to survive and germinate (Gupta, 2016).

Inclusion of non-traditional ingredients such as tomatoes, bacon, onions, and peppers are what defines a savory jam. Savory jam represents a new category of jam products and has become a growing trend among the canning community due to their unique sweet and salty flavor combination. This new category of jam features a main ingredient that is considered in the culinary

world to be savory. In addition to evolving flavor profile preferences, the increase in local produce and availability of new ingredients at the supermarket has led to home canners becoming more creative with recipes (Goard et al., 2013; Gupta, 2016; Azcentral, 2014). A survey in 2015 found that bacon and tomato-based jams were among the top trends for condiments (Gupta, 2016).

1.7 Lack of Safety Guidance for Savory Jam

There are currently no established guidelines for savory jam preservation, making regulation of safety in the home and commercial canning operations extremely difficult. The FDA Code of Federal Regulations (CFR), Title 21 CFR, explains the standards of identity for various commercial food categories. Jams and jellies are recognized in 21 CFR under fruit preserves and jams, which currently only includes fruit formulations. No standard exists for the inclusion of savory ingredients, except for tomatoes (21 C.F.R. § 150.160, 2019). The absence of this information was reinforced by a recent personal communication with a USDA representative. During the correspondence, the representative indicated that there is currently no available information regarding savory jam regulations (USDA Customer Support Agent, personal communication, 2020). The expert then recommended contacting local Cooperative Extension offices and canning consultants for further information regarding the safety of this product type.

As previously mentioned, the addition of high pH ingredients reduces the concentrations of the acidulants required to inhibit pathogen (*C. botulinum*) survival or growth (Laborde et al., 2019). If bacon that includes nitrites (up to 120 ppm) this can act as an added hurdle to overcome sporulation (Jackson, 2010).This pathogen needs to be taken into consideration since a lot of savory jam recipes are not canned at all or do not use the processing methods able to kill *C. botulinum.* The jams made for refrigerator and freezer storage can be kept under refrigeration for

three weeks, and the freezer for up to a year (NCHFP, n.d.a). Consumers may believe that fat or salt found in bacon, a common savory jam ingredient, extends the shelf life, which can produce a lack of understanding of risks associated with the use of low acid ingredients (Huff, 2009). For validated recipes from experts in food safety, home canners should consult the National Center for Home Food Preservation or a local Cooperative Extension office.

1.8 Cooperative Extension

The Smith-Lever Act of 1914 was created to encourage USDA and land-grant universities, such as the University of Maine, to develop agriculture-based education programs (USDA, n.d.). The act was first established to provide food safety information to individuals living in rural areas, by offering a direct contact method to consult with food safety experts (USDA, n.d.). This gave rise to the Cooperative Extension Service, which was created to help bridge the gap between consumers and science for agriculture. When the act was established, it was helpful for those living in rural areas to have contact with an expert (USDA, n.d.). Cooperative Extension is associated with a variety of safety-related programs, including HACCP (hazard analysis and critical control points) and FSMA (food safety modernization act).

Cooperative Extension is a valuable resource to home canners seeking information regarding home food preservation. Every land-grant university has an extension department with experts dedicated to food preservation. The University of Maine extension website, for example, provides information from the National Center for Home Food Preservation as well as guidance manuals for safe home canning. The most important note made on the website is that there is new information for canning and that canners should double-check safety information before processing (University of Maine Cooperative Extension, n.d.). Extension agents should be the

primary contact when consumers have questions regarding food safety. They are a trusted source when it comes to these questions, recommending tested recipes found in The *Complete Guide to Home-Canning* as a credible source (Clemson Cooperative Extension, n.d.b).

1.9 Recipe Evolution & New Media

As a society, we have changed the way we discover new recipes due to the rise in new media outlets. These outlets have transitioned from oral record-keeping to on-demand video. The first cookbooks were published in 1742 (Almanza et al., 2017). The transition to food on television came when Reese Schonfeld, founder of CNN, took the opportunity to create a network focused on food (Ketchum, 2009). Food Network reaches over 100 million viewers monthly (Food Network, n.d.). In the subsequent years, expanding access to the internet drove the establishment of personal weblogs (blogs), many of which focus on hobby pursuits such as cooking, commonly providing recipes, photos, and detailed written instructions. More recently, blogs have begun to transition to video blogs (vlogs) or collections of videos comprising channels on streaming services (most notably YouTube). It has been noted that close to half of millennials watch food videos (Delgado et al., 2014). As more home cooks and canners look to non-expert sources, such as cookbooks, blogs, and YouTube, for recipes, it is increasingly important to evaluate the presentation of food safety messaging in these channels.

1.9.1 Cookbooks

Cookbooks have evolved over time in terms of both audience and purpose. The first American cookbook was introduced in 1742 and was intended more as instruction for nourishment rather than use as a hobby that we see today (Almanza et al., 2017). The first cookbooks were geared toward an audience that included housewives and servants due to the role of most women

at the time (Almanza et al., 2017). This transitioned during the early- to the mid-20th century during wartime when the USDA would publish guides on how to preserve victory garden produce (Almanza et al., 2017). Today, cookbooks are meant mainly for entertainment and focus on specialized areas of cooking such as the grill, vegan cuisine, etc. (Almanza et al., 2017; Ottolenghi & Hayward, 2015).

Cookbooks are currently not evaluated for food safety messaging. Nevertheless, consumers often use them as the first source for safety information, which means this should be considered in the publishing process (Griffith et al., 1994). Worsfold recommends a two-step publishing process, the first step being the identification of any possible risk with the ingredients utilized and the second being a method assessment for risk (Worsfold, 1995). An individual linked to an outbreak of botulism from home-canned green beans and carrots in 2008 in Ohio used a recipe from a cookbook that recommended pressure canning (Date et al., 2011). The individual did not have a pressure cooker and decided to use a water bath method for one hour (Date et al., 2011). If the implications of this choice on the safety of the food had been adequately addressed, an outbreak could have been avoided.

1.9.2 Food Safety on Television

James Beard hosted the first cooking show in 1946, followed by the beloved Julia Child in 1963, known for transforming food television with “The French Chef” (Adema, 2000; Pollan, 2009). After the success of Julia Child, and after realizing that food was the most advertised type of consumer product, Reese Schonfeld created the Food Network in 1993 (Ketchum, 2009). The cooking shows produced by the network gained in popularity due to the fact that they were personal to the home cook, the host would make suggestions saying, ‘you should…’ (Ketchum, 2009). The

network continues to evolve, changing its target audience away from the original female-only audience (NPR, 2014). While Food Network is known for hosting experts in food and providing a diverse array of recipes, it is not a perfect demonstrator of food safety recommendations. Viewers become familiar with the hosts, and viewership is as much about who is cooking as it is about what is being cooked (Pollan, 2009). This familiarity can give rise to a sense of trust that can cause viewers to overlook unsafe practices. A study of over 100 cooking show episodes hosted by 24 "celebrity chefs" evaluated "safe" and "unsafe" food safety actions. Some "safe" practices would include handwashing, wearing visibly clean clothing, and washing fruits and vegetables (Anderson et al., 2004). "Unsafe" practices would include cross-contamination, improper cooking times, and the exclusion of washing hands, among others (Anderson et al., 2004). Only 25% of the chefs observed talked about cooking temperature, and only 33% cleaned their cutting board after using it for raw meat (Maughan et al., 2017). The occurrence of these unsafe habits has been continually identified as a trend in various studies examining food shows (Cohen & Olson, 2016). Less than 10% of the shows analyzed exhibit proper produce handling and time and temperature monitoring procedures (Cohen & Olson, 2016). The visual depiction of poor food safety habits is seen and then likely to be repeated by home cooks, potentially becoming habitual (Fischer & Frewer, 2008; Fischer & De Vries, 2008).

Cooking becomes a habitual skill from repetitiveness over time, making the cooking process automated, without thought behind processing (Aarts & Dijksterhuis, 2000; Fischer & De Vries, 2008; Fischer & Frewer, 2008). A home cook looking for guidance on a recipe is highly likely to imitate the actions of the show's host (Maughan et al., 2017). Because of this, participants in studies are less likely to self-report actual behaviors. In one study on self-reporting of food safety practices, participants were asked if they always wash all produce before use. Those

participants answering “yes” were asked if they wash melons (a type of produce), to which the response would often change to “not always” (Kendall et al., 2004). This study demonstrates the surface-level thought going into these responses. It has been documented in multiple research studies pathogens from the rind of melons, and other foods come into contact with the inside flesh during cutting, presenting the potential of causing foodborne illness (Parnell et al., 2005; Gayler et al., 1955; Walsh et al., 2014; Callahan, 2019).

Researchers performed a study to observe consumers’ food safety behaviors (Anderson et al., 2004). Participants were observed at home using a multiple camera set up to assess the frequency of a variety of actions, including hand-washing, surface cleaning, and vegetable cleaning (Anderson et al., 2004). The results from that study also followed the trend of previous work observing consumers, with cross-contamination from touching raw and cooked samples observed in 51% of the 99 participants in the study with 20% of unsafe handwashing practices due to contamination of raw and cooked ingredients (Anderson et al., 2004). Several authors have noted that the reason for the omission of food safety information from television cooking shows is due to air time capacity for the programs (Maughan et al., 2017; Irlbeck et al., 2009). This uncovers another issue with food television; that it is not feasible for a thirty-minute show to contain all of the necessary food safety information and instructions for a meal (Irlbeck et al. 2009). It is reasonable to expect that this problem is only exacerbated as more short-form content becomes the focus of consumer preference. Consumers are looking for shorter videos so they can consume more content; almost 75% of those who watch videos spend less than five minutes on consuming the media (Patton, 2017).

1.9.3 Food Safety on Blogs

Blogs have become a new method for recipe sourcing by consumers, who are increasingly transitioning from face-to-face communication and books as sources for information toward online sources for added accessibility (Ho & Chien, 2010; Trammell & Keshelashvili, 2005; Savoie & Perry, 2019). There are more than five million visitors to some food blogs every month (Alexa Internet, n.d.; Morrison & Young, 2019). Bloggers are usually self-published and thus control what information is being shared on the internet. The individual reader of the blog is what determines what information is absorbed and what is not (Ho & Chien, 2010). The reader decides whether to trust the information provided; Ho and Chien found that when a reader believes the credibility of the author, they are more willing to come back again and trust the messages provided (Ho & Chien, 2010).

Most blogs provide recipes along with a combination of personal anecdotes and kitchen tips. These personal stories can make those reading/viewing feel a connection to the writer, providing added trust in the information conveyed (Savoie & Perry, 2019; Ho & Chien, 2010). A study performed by Savoie and Perry (2019) on blog recipes for canned salsas indicated that none of the blog recipes included an indication of pH control in recipes, demonstrating dramatically increased risk for foodborne illness. Another study looking at the safety messages in food blogs found that nearly 90% of the recipes evaluated used subjective indicators for knowing a dish was complete, as well as a complete lack of procedures to reduce cross-contamination risk (Morrison & Young, 2019). This establishes again that the messages being put out by blogs are not subject to oversight, and can contain risky behaviors when canning or cooking. Home canners and home cooks alike use these visuals and personal stories to add credibility to the author when, in reality, they may not possess expertise in this area.

Modifying validated recipes can have a detrimental effect on the safety of home-canned products. Michigan State University Extension states that one should never alter tested recipes, especially by changing processing methods, because incorrectly canned jars have an enhanced risk of botulism (Nichols, 2013). Measurement is another factor that challenges the safety of home-canned products. For example, “one cup of diced onions” versus “one onion, diced” can change the acidity of a product and potentially its safety (Savoie & Perry, 2019). Home canners may have only certain ingredients in their home or access to certain ingredients. Home canners innocently replace lemon juice with vinegar expecting the taste and end product to be the same when in reality, the acidulant should not be substituted due to differing levels of acidity (Nichols, 2013).

Substitutions such as Granny Smith apples for Gala apples are encouraged by bloggers for demonstrating consumer creativity. However, such variations in the formulation can impact safety. Several publications by blogger Marisa McClellan, including books, videos, and blog posts on canning, one of which provides a guide to canning creatively, are perfect examples of this concern. The author highlights experimenting with flavor mixtures, which, unfortunately, drastically alter the pH of the finished product. When a limited amount of acidulant is used, adding a less acidic fruit to the combination can mean the recommended pH of 4.6 will not be reached (McClellan, 2010; USDA & National Institute of Food and Agriculture, 2015; Gupta, 2016). McClellan also incorrectly states that sugar does not contribute to safety, only acidity does. Her suggestion, however, is contradicted by the USDA’s *Complete Guide to Home Canning* (McClellan, 2010; USDA & National Institute of Food and Agriculture, 2015). With the rise of savory jam and the current lack of government guidance for safe production, the preparation of this product involves even more risk since typical jam ingredients, and ratios may not be utilized.

1.9.4 YouTube

YouTube is a new platform for a variety of subjects, including food, recently gaining popularity. Since 2005, YouTube has become a widely accessible outlet for sharing content on a wide range of topics (Rhoades & Ellis, 2010). The content can vary from cooking to gaming and everything in between (The Artifice, 2015; Rhoades & Ellis, 2010). YouTube has even been able to offer careers to amateur bloggers who are promoted to vloggers (video bloggers), making their living through advertising revenue and sponsorships from consumer brands. The platform created by this streaming site has given amateurs and experts alike a space to give recommendations with no distinction between opinion and scientific fact. Often this leads to negligence of safety principles, which in terms of canning, includes omission of key processing details like boiling time, which is glazed over if mentioned at all, even though almost half of the major cities in the U.S. are considered to be at high altitudes, requiring extensions of processing times for safety (Savoie & Perry, 2019).

There are hundreds of hours of video content sent to YouTube every minute (Iqbal, 2018). This platform is dependent on the constant, almost real-time creation of new content. The demand for content means that amateur vloggers may not be able to properly research unfamiliar topics or review content for factual accuracy before posting. Another quirk of the platform is that this content is available to consumers in perpetuity and is unlikely to undergo revisions for accuracy. Home preservers can find an onion jam recipe in seconds on YouTube. By simply entering a recipe concept such as “savory jam” into the search bar, thousands of results are returned almost instantaneously. There are over 174,000 video results related to the canning of jam on YouTube. For a savory jam, that number reduces drastically to 91,000. The results for a “safe”

jam, meaning minimal risks in product safety, becomes potentially even more challenging to find when seeking recommendations for savory jam as opposed to traditional sweet formulations.

1.10 Safety Messages Through Video

Through the evolution of new media outlets, the effectiveness of safety messages can become unclear. In a survey given to 3,000 participants, researchers examined if the media channel had an impact on how trusting the consumer was of food safety information, it was identified that whether it is a video or a government publication, 40% of consumers are still questioning the validity of the information (Buzby & Ready, 1996). More concerning, consumers participating in this study reported trusting information in cookbooks rather than government websites (Buzby & Ready, 1996). The National Center for Home Food Preservation was created as a reputable source containing information that has been tested by experts. The apparent wariness of consumers to understand this available resource creates concern for those in Cooperative Extension work and food safety experts.

1.11 Significance and Objectives

There is currently a limited understanding of food safety messaging in YouTube recipe videos, and the likelihood of viewers to emulate safety-related habits displayed by this medium. Additionally, the magnitude of safety risks associated with savory jams is unknown.

An analysis of the availability of food safety messages related to home canning on YouTube is necessary for ensuring product safety. The goal of this research is to investigate the presence and effectiveness of food safety messages and practices presented on YouTube, for savory jam preparation, and how this media impacts home canners' safety. This will be

accomplished in three objectives: (i) to analyze food safety message prevalence on available YouTube videos and their relationship to the expertise level of the content provider, (ii) to conduct a quantitative analysis of savory jam made from recipes from YouTube, and (iii) to survey home canners regarding safety-related practices during canning. These objectives will help to determine the relationship between the food safety messages presented through video and how this translates to home canners' habits and assess recipe safety through analysis.

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CHAPTER 2

SAVORY JAM VIDEO ANALYSIS AND ITS RELATIONSHIPS TO EXPERTISE AND SAFE SAVORY JAM

2. 1 Abstract

Recipes have recently made the transition out of the typical cookbook to the internet. YouTube has seen growing use by younger generations for food-related content. This ever-expanding new media platform allows content to be created by contributors varying in expertise from amateur hobbyists to expert chefs or food safety specialists. For canned foods, the lack of detail regarding critical food safety practices, and failure to consult tested recipes, can lead to foodborne illness or intoxications. The goal of this study was to investigate the prevalence of food safety messages in YouTube videos available for a trending condiment, savory jam, and how the quality of those messages can impact the safety of a home canner's savory jam. This study consisted of two parts: the first being an analysis of current savory jam instruction recipe videos. The subsequent portion of this study involved the preparation of jam following selected videos analyzed in part one. Savory jam videos were separated into two main categories: canned and uncanned recipes. Videos were then assessed for quality of food safety messaging by observing the presence of correct ingredient and processing-related practices based on recommendations from the National Center for Home Food Preservation (NCHFP). Processing-related observations included such factors as the use of appropriate canning methods and washing of lids and jars. Ingredient-related observations included attributes such as presence and type of acidulant. Uncanned recipes were scored on a more limited set of criteria, omitting observations explicitly related to canning. Observations were scored as either positive (compliant) or negative (non-compliant) and tallied for a total video score (out of 100%). This

study suggests that the expertise level of the content creator and how closely tested guidelines are followed can have a significant impact on the quality and prevalence of food safety messages provided to the viewer. There were more recipes found for amateur expertise than any other expertise category. For uncanned processing method observations, there was an average grade of 15.15%. For canned processing method observations, the average score was 38.12%, significantly higher than the average uncanned score. The same trend was observed in ingredient-related scores. Onion jams prepared from YouTube recipes demonstrated no significant ($p > 0.05$) differences among replicates of each recipe. Values did not follow current guidelines for safe jam, including a minimum of 65% soluble solids content and a maximum of 0.85 water activity, set to minimize risks to consumers. These values for attributes in jam from recipes written by amateur creators establish that there are still deficiencies in the creation of safe content on home canning as well as safe savory jam. Providing additional information to these creators and the general public for a new, trending condiment will help minimize cases of foodborne illness and intoxication resulting from its home preparation and consumption.

2.2 Introduction

The recipe selection process among home cooks has steadily evolved over time. Initially, cookbooks were the primary information source due to availability, followed by television networks, and food blogs. Today, YouTube has become a prominent outlet for recipe sourcing among home cooks. In 2014 there were 419 million views on recipe videos (Cooper, 2015). YouTube is unique as a source for recipes for several reasons; among them, the open-access nature of the media platform and the undetermined credibility of internet content creators (Yang, 2019). With regard to cooking, a concern arises regarding the nature and quality of food safety messaging in video content created by amateurs. The ranges in expertise represented across

channels can create a dispersion in food safety behaviors seen by the viewer and can impact the safety of their final products. When focusing on home canning, a popular topic for YouTube creators, food safety recommendations set by the USDA, and National Center for Home Food Preservation may be overlooked. This concern is especially warranted for consumers engaging in home canning, where safe food handling and processing practices are critical to consumer safety.

Expert concerns about home canning safety led to the creation of the USDA's *Complete Guide to Home Canning,* and National Center for Home Food Preservation (NCHFP), which provide recipes tested by food safety specialists and Cooperative Extension agents (Clemson Cooperative Extension, n.d.). Historically, home canning has increased during times of economic hardship (such as recessions and wartime) (Goard et al., 2013). Recently there has been an increase due to the popularity of purchasing organic and local ingredients as well as home canning projects, and the COVID-19 pandemic (Goard et al., 2013; Gupta, 2016; Hartman, 2015; Turner, 2020). The recent popularity in canning has resulted in increased creativity in recipe development due to improved access to ingredients. As a result, an array of different canned products have emerged, including savory jams (Goard et al., 2013). Savory jam is a relatively new condiment category that combines sweet and salty flavors through the addition of a savory main ingredient, such as bacon, onions, tomatoes, and or chili peppers. This increasingly popular condiment has yet to be included in the USDA *Complete Guide to Home Canning* or to be addressed in publications from the National Center for Home Food Preservation. The absence of this information could lead to improper formulation development or processing instructions, which may enable opportunistic pathogens or fungi to survive within the food medium. These unsafe canning practices could potentially result in severe health conditions, including foodborne

botulism. From 1996 to 2008, for example, close to 40% of foodborne botulism outbreaks were attributed to home-canned products, demonstrating the need to ensure that safe practices are being followed closely (Mackin, 2018).

As a result of the absence of validated savory jam recipes for home canners by the National Center for Home Food Preservation and the emergence of potentially non-credible online resources on platforms such as YouTube; examination of available safety messages and the impact of this unregulated media platform on home canning practices is critical. Therefore, the objectives of the present study are to (i) inspect the frequency of food safety messages in savory jam YouTube videos, (ii) determine how expertise may affect the prevalence of these messages, and (iii) assess the safety of these recipes for the home canner by evaluating such factors as Brix, pH, and water activity.

2.3 YouTube Video Search Materials and Methods

2.3.1 Screening Tools

Before video procurement, a number of categories were established to assess the prevalence of food safety practices in savory jam videos available through YouTube. The first distinction among videos was categorizing "uncanned" versus "canned" recipes. Specifically, "canned" recipes were defined by the use of heat to process jars; this includes inversion, processing in a boiling water bath or a pressure canner (Table 2.1). "Uncanned" recipes, on the other hand, were those which did not use heat processing of jars and subsequently recommended refrigeration or freezing of the jam (Table 2.2). Another criterion assessed the expertise level of the recipe source. This criterion comprised three different expertise levels: "amateur," "intermediate," and "expert." "Amateur" rankings were given when the creator (colloquially

known as YouTuber), had no apparent prior expertise in food safety or home canning or commonly used home canning as a hobby. Commonly, these creators were individuals maintaining their own YouTube channels. “Intermediate” expertise was defined as creators having some expertise and or extra credentials in the food industry, commonly organizations such as a magazine publication. The highest expertise level (“expert”), was classified as food safety and/or Cooperative Extension specialist.

Within these categories, videos/recipes were evaluated for quality of food safety messaging based on ingredient selection and processing method observations taken from recommendations put out by the USDA, *Complete Guide to Home Canning*, and NCHFP website. Ingredient-related observations included the inclusion of ingredients of certain types (acid/sugar), which would potentially affect product safety (Table 2.3). The most notable ingredient considerations included sugar sources, sugar substitutions or reductions, acidulant type and usage, and inclusion of low-acid main ingredients. Process method observations were based on processing method (inversion, boiling water bath, or pressure) selection, processing time, cleaning steps (lids & jars, hands, produce), method of measuring, the inclusion of extra home-canning/food safety resources (USDA & NCHFP), and whether topics like labeling and vacuum sealing were mentioned. Complete screening criteria can be viewed in Table 2.3.

2.3.2 Video Search

YouTube was used to search for savory jam recipes. Searches included both generalized terminologies such as “savory jam recipe” as well as those specific to the main ingredient such as “onion jam,” “bacon jam,” “red pepper jelly,” and “tomato jam.” Both search term forms were used to ensure variation in the available videos as well as variation in expertise among video sources (Table 2.4). Original sourcing of these videos took place from July 2019- November

2019. Videos were excluded if they did not include a voiceover or dialogue from the author of the video. A summary of the videos analyzed is listed in Tables 2.1 and 2.2 (for canned and uncanned recipes, respectively).

Table 2.1: Canned Savory Jam Recipes Evaluated for Food Safety Messaging

Name of YouTube Channel	Subscriber Count [B]	Video Views [C]	Expertise Rank	Main Ingredient
2leelou Creates	11,000	1,880	1	Onion
America's Test Kitchen	741,000	159,526	2	Fruit [A]
Apron Strings	1,090	464	1	Onion
BallCanning	12,000	6,976	2	Chili Pepper
Burleigh County Extension	9	81	3	Fruit
Dave's Homestead	35,900	31,571	1	Chili Pepper
Everyday Food	1,300,000	129,509	2	Fruit
Food Network	702,000	4,171	2	Fruit
Grandma Cheap Cheap	21,400	3,371	1	Tomato
Grey Goose Gourmet	2,580	82,840	1	Chili Pepper
Howcast	7,580,000	105,533	2	Fruit
Inside Kate's Kitchen	1,550	281	1	Onion

Table 2.1 Continued				
Jessiejam Homestead	3,900	1,291	1	Zucchini
Lowe's Home Improvement	748,000	139,586	2	Fruit
Marisa McClellan	52	Unlisted	1	Tomato
NDSU Extension	4,940	728	3	Fruit
Nerissa Nikole	25,600	739	1	Onion
OldManCooking	50,000	30,901	1	Chili Pepper
Penn State Extension	3,110	869	3	Fruit
Praxxus55712	Unlisted	37,307	1	Fruit
Prepper Potpourri	12,000	916	1	Tomato
Saveur magazine	29,000	5,295	2	Fruit
Shadow of Juniper Hill	4,550	7,100	1	Tomato
Teasers Pleasers	1,870	275	1	Bacon
The Layne Homestead	1,700	14,999	1	Onion
Twin Cities Adventures	35,600	8,779	1	Chili Pepper
University of Illinois Extension	11,300	20,520	3	Fruit

Table 2.1 Continued				
Wilhelms Kitchen	14,000	2,021	1	Chili Pepper
painhammer4560	221	4,891	1	Chili Pepper

A- Fruit based recipes were included in the dataset due to complete lack of savory jam videos falling into the “expert” or “intermediate” category
B/C- Videos views and subscriber counts are subject to change. Original sourcing of these numbers was from July 2019- November 2019.

Table 2.2: Uncanned Savory Jam Recipes Evaluated for Food Safety Messaging

Name of Channel	Subscriber count [A]	Views on the video [B]	Expertise Rank	Main Ingredient
Allrecipes.com	1,300,000	19,679	2	Bacon
Bon Appetit	4,480,000	2,367	2	Chili pepper
Casa Chiesi	1,080	1,509	1	Onion
Chef Clayton Chapman	1,810	869	1	Bacon
ChefRLI's Kitchen	Unlisted	1,914	1	Onion
Cooking with Ry	71,000	4,437	1	Bacon
Diana DeLaFuente	71,900	7,768	1	Bacon
EATS	4,060	1,700	1	Bacon

Table 2.2 Continued				
Feast Magazine	4,660	4,600	2	Bacon
Glori Winders, The 31 Woman	826	8,295	1	Bacon
Holista	14,000	1,599	1	Bacon
Imperfect Foods	221	125	2	Onion
Katie Pix	31,600	23,977	1	Chili Pepper
Keef Cooks	623,00	27,345	1	Chili Pepper
King Estate Winery	187	13,771	1	Tomato
Paola Westbeek	131	535	1	Pepper
Pitmaster X	326,000	33,457	1	Bacon
Simply Sara Kitchen	122,000	46,000	1	Bacon
The Domestic Geek	1,680,000	69,000	1	Bacon
The Domestic Geek	1,690,000	69,731	1	Bacon
The Stay at Home Chef	444,000	44,069	1	Bacon

A/B- Videos views and subscriber counts are subject to change. Original sourcing of these numbers was from July 2019- November 2019.

Table 2.3: Screening Criteria for Savory Jam YouTube Videos

Guideline	Scoring Criteria	Ingredient Related or Processing Method Category	Included for Canned or Uncanned Recipes
Expertise Rank	• Top-level: Expert • Mid: Intermediate • Bottom-Level: Amateur	Both	Both
Acidic Main Ingredient (acidic or low-acid)	• Top-level: Acidic • Bottom-level: Non-Acidic	Both	Both
Acidulant	• Top-level: lemon juice, vinegar variation (distilled, apple cider, sherry, balsamic) • Mid-level: coffee • Bottom-level: wine or juice	Ingredient	Both
Sugar Variety	• Top-level: White sugar or brown sugar • Middle-level: Molasses, honey, or maple syrup • Bottom-level: Juice	Ingredient	Both
Decreasing or Replacing Sugar	• Top-level: No decreasing/replacing • Bottom-level: Decreasing/Replacing suggested	Ingredient	Both
Water Headspace	• Top-level: 1 or more inches above jar • Bottom-level: Less than 1 inch or not specified	Processing	Canned
Boiling Time	• Top-level: 10-15 minutes • Bottom-level: Less than 10 minutes or not specified	Processing	Canned
Canning Method	• Top-level: Pressure/Water Bath • Bottom-level: Inversion	Processing	Canned

Table 2.3 Continued			
Cleanliness/ Sterility of Jars	• Top-level: Discussed/demonstrated • Bottom-level: Excluded	Processing	Both
Seasonality/Substitution for the Main Ingredient	• Top-level: Discussed • Bottom-level: Excluded	Ingredient	Both
Washing Produce	• Top-level: Demonstrated/discussed • Bottom-level: Excluded	Processing	Both
Measurement Style of Ingredients (acidulant, sugar, etc.)	• Top-level: Volumetric/Weight • Bottom-level: Not measured	Processing	Both
Whole Commodity Measuring of Main Ingredient	• Top-level: Excluded • Bottom-level: Demonstrated/discussed	Processing	Both
Goal Temperature	• Top-level: Discussed/specified • Bottom-level: Excluded	Processing	Both
Headspace Measurement in the jar	• Top-level: ¼ in • Bottom-level: ½ in and above	Processing	Canned
Labeling Contents of Jar	• Top-level: Discussed • Bottom-level: Excluded	Processing	Both
Type of Top Used	• Option 1: One Piece • Option 2: Two-Piece • Option 3: No top	Processing	Both
Washing Lids (To ensure vacuum seal)	• Top-level: Included/discussed • Bottom-level: Excluded	Processing	Both
Vacuum Seal of Jars	• Top-level: Discussed • Bottom-level: Excluded	Processing	Canned
Storage Method After Canning	• Option 1: Shelf • Option 2: Fridge/Freezer	Processing	Canned

Table 2.3 continued			
Shelf Life Estimation After Processing	• Level 1: 0-14 days • Level 2: 1-12 months • Level 3: 1-2 years • Level 4: Excluded	Processing	Canned
Washing Hands	• Top-level: Demonstrated/discussed • Bottom-level: Excluded	Processing	Both
Safety/Safe Phrases Spoken by Narrator	• Top-level: Included • Bottom-level: Excluded	Processing	Both
Sources of Additional Information Provided (USDA & NCHFP)	• Top-level: Included • Bottom-level: Excluded	Processing	Both

Jam Analysis Materials and Methods

2.3.3 Recipe Selection

Three canned YouTube-based onion jam recipes from amateur-level contributors were selected for use in this study (Table 2.4). Recipes were also chosen due to the variety of sugar and acidulant sources represented among them. Each of three volunteer home canners prepared each jam recipe one time. Each volunteer prepared one recipe on each of three separate days. Beyond recipe comprehension among viewers, finished jams were also analyzed to determine if the difference in pH, Brix, or water activity of the final product had a potential impact on finished product safety.

Table 2.4: Onion Jam Recipe Selections Prepared by Volunteers

Name of YouTube Channel	Acidulant	Sugar
2leelous Creates	Balsamic Vinegar	Maple Syrup and White Sugar
Inside Kate's Kitchen	Vinegar	Sugar
Linda's Pantry	Balsamic Vinegar	Dark Brown Sugar

2.3.4 Instructions for Participants

Three volunteers familiar with making jams at home were selected to participate in the study. Participants were randomly assigned to make one of the three jams on each of three days, such that no participants were simultaneously preparing the same recipe. Prior to jam making, participants were given written instructions but not given the link to the video source (Appendix A). On the day of jam making, participants were invited to the University of Maine Commercial Kitchen (Orono, Maine), where they were first instructed to watch the YouTube video. Participants were then permitted to write down notes or questions they encountered while watching the video, and notes were collected at the end of each jam making day. Participants were then asked to make the jam following the instructions provided in the video. Participants were given the ingredients in original packaging at their work station for the recipe of the day as well as access to a variety of measuring tools, including dry measuring cups, liquid measuring

cups, and a scale. They were instructed to use a clock in the kitchen to keep track of their timing. However, in situations where instructions were omitted or unclear in the video (such as the size of diced onions), participants were asked to prepare the jam as if they were at home alone. Participants were provided ingredients for the recipe and a variety of measuring tools, depending on what method was suggested. The prepared jam was allowed to sit for 24 hours at ambient temperature before analysis to ensure a proper seal and set texture were established.

2.3.5 Water Activity

A water activity meter (Legacy Aqualab PRE; METER Group Inc., Pullman, WA, USA) was calibrated using 0.760 and 0.984 A_w NaCl standards before sample measurements. Following calibration, jam samples were then filled to the halfway mark of the sample cup in accordance with manufacturer instructions. Readings were completed in triplicate for each sample and averaged.

2.3.6 °Brix

Triplicate readings were obtained using a calibrated Pocket Refractometer (PAL-3, ATAGO, Tokyo, Japan) for each sample. Deionized water was used as a blank.

2.3.7 pH

The pH was determined using a Hanna pH meter (Edge Model, HI2020 Probe; Hanna Instruments, Woonsocket, RI). The pH meter was calibrated using buffers 4, 7, and 10. Readings were completed in triplicate per sample and averaged.

2.3.8 Statistical Analysis

Data were analyzed using SPSS (IBM Corp, Armon, New York) for statistical correlation ($p < 0.05$) between food safety-related behaviors (Table 2.3) demonstrated in YouTube videos as

well as expertise level of the video source. Measurements taken on prepared jams were analyzed to determine the presence of significant differences between replicates and recipes using ANOVA and Tukey's HSD in R Studio (Boston, MA, Version: 1.2.1335).

2.4 Results

2.4.1 Savory Jam Video Overview

Canned savory jam videos (n =29, Tables 2.2 & 2.5) had viewings between 81 and 159,526 across all expertise levels, averaging 28,657 views per video. However, there were generally fewer views on videos from expert-level sources, with an average of 5,550 compared to amateur- and intermediate-level sources with 13,507 and 78,657 average views, respectively. Uncanned savory jam video (n=21, Tables 2.3 & 2.5) viewership ranged between 125 to 69,731 per video across all three expertise levels averaging 18,226 views per video.

Table 2.5: Expertise Breakdown for Savory Jam Canned and Uncanned Videos

Expertise Level	Canned Videos	Canned Video Views	Uncanned Videos	Uncanned Video Views
1 (Amateur)	18	13,507 ± 21,654	17	20,939 ± 23,743
2 (Intermediate)	7	78,656 ± 70,271	4	6,692 ± 8,848
3 (Expert)	4 [A]	5,549 ± 9,986	0	NA

A- All expert level recipes were fruit-based jam recipes

Canned recipes included a wider variety of ingredients compared to their uncanned counterparts, including onion, chili peppers, tomatoes, zucchini, and bacon (Figure 2.1). However, despite this variety in recipe formulation, we were unable to find recipes for any

canned savory jam from expert-level sources. Therefore, fruit-based recipes were included in this analysis to demonstrate the information quality of an expert-level instructional video. Specifically, videos from expert-level sources were included in this evaluation to demonstrate how the number of safe home processing practices could be related to the expertise level of the content creator. Uncanned recipes were far less expansive in terms of ingredients and only included onion, chili peppers, tomatoes, and bacon. The most popular uncanned variety of savory jam was bacon, making up 61.9% of the recipes found (Figure 2.2).

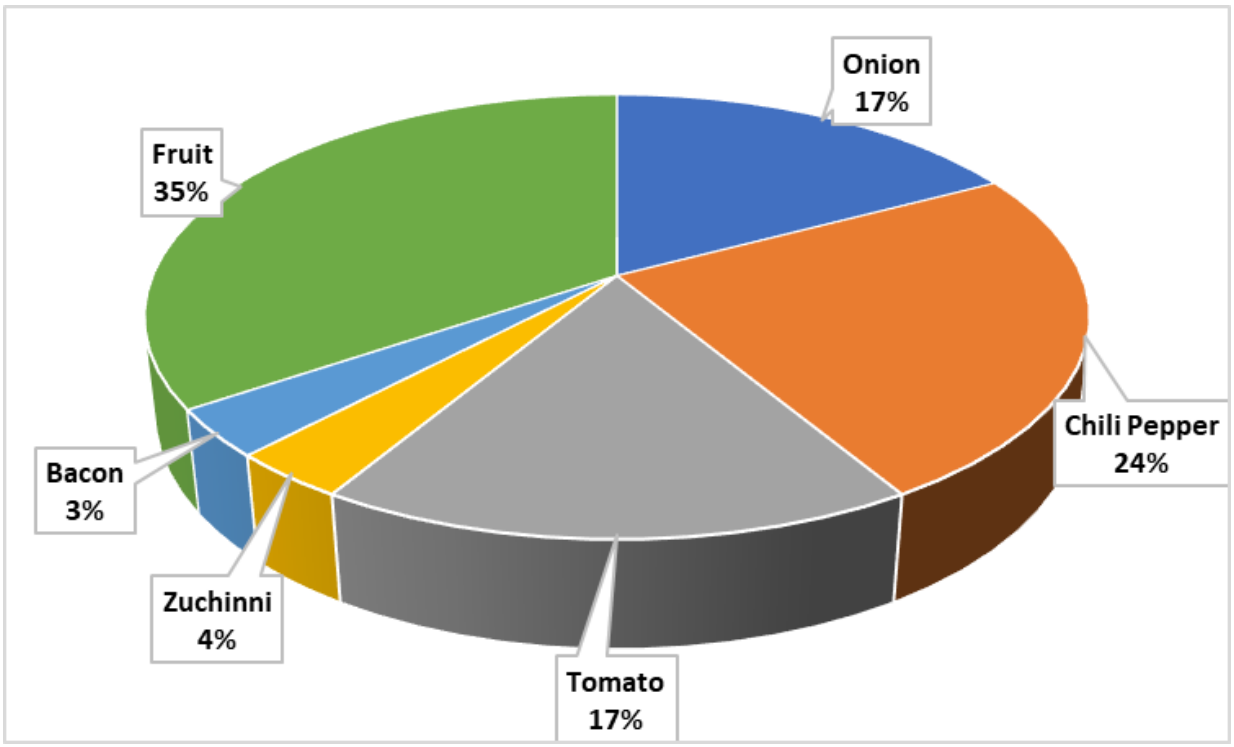

Figure 2.1: Canned Savory Jam Main Ingredient Breakdown [A]

A- Canned savory jam videos (n= 29) sourced from YouTube (July- November 2019) (Table 2.1)

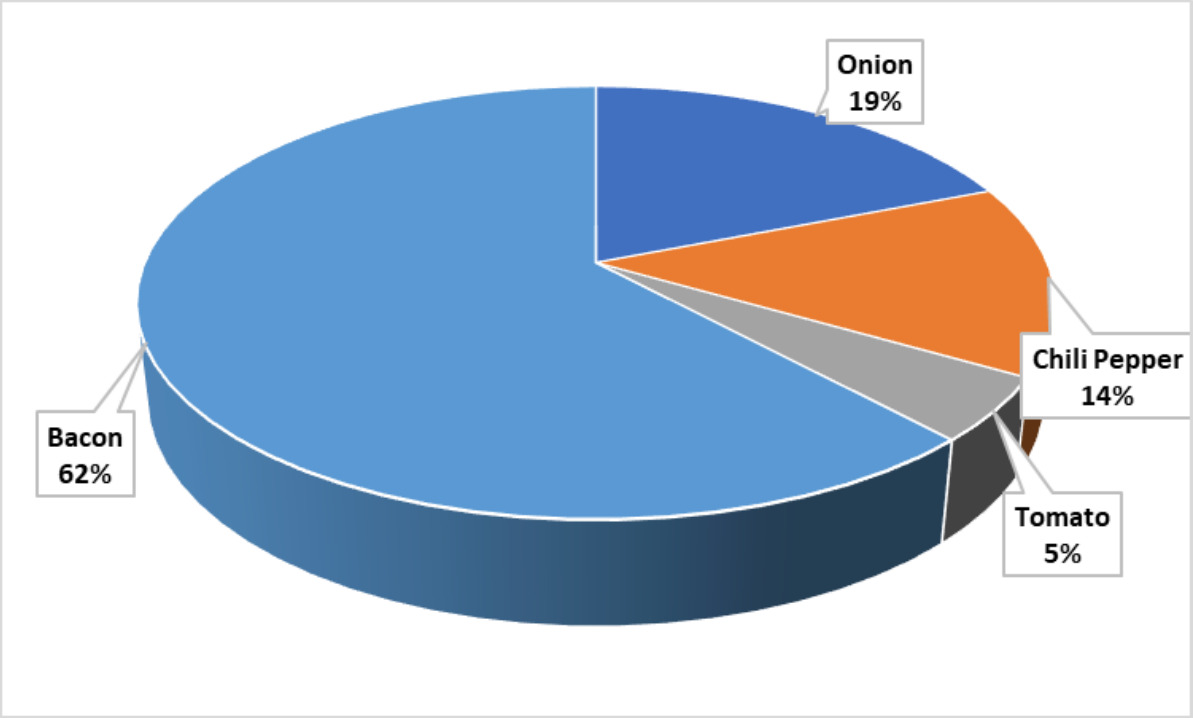

Figure 2.2: Uncanned Savory Jam Main Ingredient Breakdown [A]

A- Uncanned savory jam videos (n= 21) sourced from YouTube (July- November 2019) (Table 2.2)

2.4.2 Canned Recipe Processing Observations

Preparation practices (Table 2.1) were observed for each video and summed to produce an overall score out of 100% for positive safety habits. For both canned processing and ingredient observations, the combined overall average score was 59.6%. Uncanned processing and ingredient observations gave an average positive score of 42.1%. Video attributes were then further separated into two categories: processing methods and ingredient related observations. Attributes that were not applicable to the video (e.g., canning-related observations for uncanned recipes) were not included in the total score. There was a wide range in overall positive habit

scores (Figure 2.3) for canned processing methods across videos, ranging from 11.1% to 66.7% per video. The average positive habit score was 38.1% (Table 2.6).

For canned jam videos, a higher number of views demonstrated a significant relationship ($p < 0.05$) with an overall positive habit score. However, the channel's subscriber count was not related to positive habits score.

In order to determine if the National Center of Home Food Preservation and *Complete Guide to Home Canning* suggestions were followed, videos were examined for additional information or reference to those specific resources. Videos referencing expert sources for further information were significantly more likely to feature washing of produce, but not handwashing. Additionally, including the practice of washing lids was significantly ($p < 0.05$) correlated with the provision of information regarding the sterility and cleanliness of jars and tops (Table 2.3).

2.4.3 Uncanned Recipe Processing Observations

For uncanned savory jam videos (Figure 2.3), there was a range of positive habit scores from 0% to 36.36% (mean = 15.15%) (Table 2.6). Using whole commodity measuring for the main ingredient (one pepper) was associated with ($p < 0.05$) a higher score for the overall positive habits seen in a video.

2.4.4 Canned Recipe Ingredient Related Observations

In addition to ingredient measurement, the impact of ingredient selection (such as the acidity of the main ingredient, sugar presence, replacement /reduction, acidification, and seasonality) on positive preparation habits were assessed. There is a range for positive habits seen (Figure 2.3) for the canned ingredient related observations from 50% to 100%, with an

average score of 81.03% for the inclusion of positive habits (Table 2.6). This suggests that among recipes for savory jams on YouTube, methodological, as opposed to ingredient, errors are more likely to be demonstrated to viewers due to the higher average in ingredient-based observations. The relationship between canned processing methods and ingredient-based observations demonstrated a significant difference ($p < 0.001$). Using traditional sucrose and not reducing the amount or a substitution demonstrated a significant relationship to ($p < 0.05$) the number of positive preparation habits seen in a video. Main ingredient selection (acidic or non-acidic) and seasonality (in or out of season/variety), both significantly ($p < 0.05$), impacted the number of observed positive habits. Including acidic main ingredients and discussing the seasonality of ingredients relates to overall positive habit scores.

2.4.5 Uncanned Ingredient Related Observations

Finally, the uncanned ingredient related (Figure 2.3) also demonstrated a range in positive habit scores from 25% to 100% and an average score of 69.05% (Table 2.6). The values between uncanned ingredient related observations and uncanned processing scores were significantly different ($p < 0.001$). Ingredient based observation scores were higher than the processing method scores, which is demonstrated in their relationship comparison. Interestingly, this suggests that videos demonstrating the preparation of non-shelf stable savory jams are less likely to deviate from standard ingredients than to demonstrate unsafe preparation practices. Using a traditional standard sugar like brown sugar or white table sucrose was related to significantly ($p < 0.05$) higher percentages of observed positive habits. However, no relationship between the use of a standard acidulant like lemon juice or vinegar (as opposed to wine or fruit juice) and total positive habit scores was observed.

Similarly, utilizing a sugar replacement or cutting sugar quantities also did not have a significant ($p > 0.05$) effect on the total number of positive habits within a video. Both main ingredient acidity and discussing the seasonality of ingredients were shown to be significant ($p < 0.05$) and influence the number of positive habits demonstrated per video. For both canned and uncanned ingredient related observations, there was a relationship that was almost not significant ($p= 0.042$). This demonstrates that these videos share the most similarities in faults with ingredient related observations regardless if the recipe is later canned or not.

2.4.6 Canned and Uncanned Combined Results

Overall, positive habit percentages show a wide dispersion due to factors, including views and source expertise level (Figure 2.3). The relationship between expertise and type of acid demonstrates that YouTubers with higher expertise and more likely to use standardized acids as well as include viable resources like NCHFP. Negative correlations, however, were found in relationships comparing views to washing jars/lids before processing, as well as labeling jar contents, meaning that more viewed videos are less likely to contain this information. Additionally, mentioning keywords such as “safe” or “safety” was positively correlated with a discussion of seasonality and ingredient substitutions in videos. There was also a positive correlation between handwashing and produce washing, demonstrating cleanliness by the YouTubers. The practice of handwashing was also positively correlated with labeling contents and was negatively correlated with whole commodity measuring.

However, uncanned recipes had different correlations (Table 2.7), which included the cleanliness of lids, which was negatively correlated with the variation of acid ingredients, demonstrating creators that talk about cleaning lids are likely to use a non-traditional acidulant.

Videos using the whole commodity as a mode of measurement were more likely to use a non-traditional sugar source.

Uncanned and canned overall combined scores for ingredient-based observations and processing method observations were found to be significantly different ($p < 0.05$), which indicates that canned recipes had higher scores than the uncanned recipes.

Table 2.6: Overall Grades for Uncanned and Canning Processing and Ingredient Related Observations

Category of Methods	**Average Score**	**Grade [A]**
Uncanned Processing-related	15.15	F
Canned Processing-related	38.12	F
Uncanned Ingredient-related	69.04	D+
Canned Ingredient-related	81.03	B-

A- (CollegeBoard, 2017)

Table 2.7: Correlations for Canned [A] and Uncanned [B] YouTube Savory Jam Videos

Canned Correlations		
Relationship Examined [C]	**Effect**	**p-value**
Expertise and including extra information	Positive	0.030
Expertise and type of acid	Positive	0.021
Subscriber and views	Negative	0.012
Views with the likelihood of washing jars	Negative	0.019
Views with the likelihood of labeling contents	Negative	0.043
Washing jars/lids with discussing lid cleanliness	Positive	0.002
Discussing clean lids and vacuum seal	Positive	0.026

Table 2.7 Continued		
Mention of safety and discussing seasonality of ingredients	Positive	0.026
Produce washing and handwashing	Positive	0.026
Handwashing with labeling contents	Positive	0.026
Handwashing with measuring by the whole commodity	Negative	0.033
Labeling contents with a vacuum seal	Positive	0.003
Uncanned		
Cleaning lids and acid type	Negative	0.042
Measuring by the whole commodity and discussing seasonality of ingredients	Positive	0.027

A- Youtube videos (n=29) are found in Table 2.1
B- Youtube videos (n=21) are found in Table 2.2
C- Basis of levels and factors are found in Table 2.3

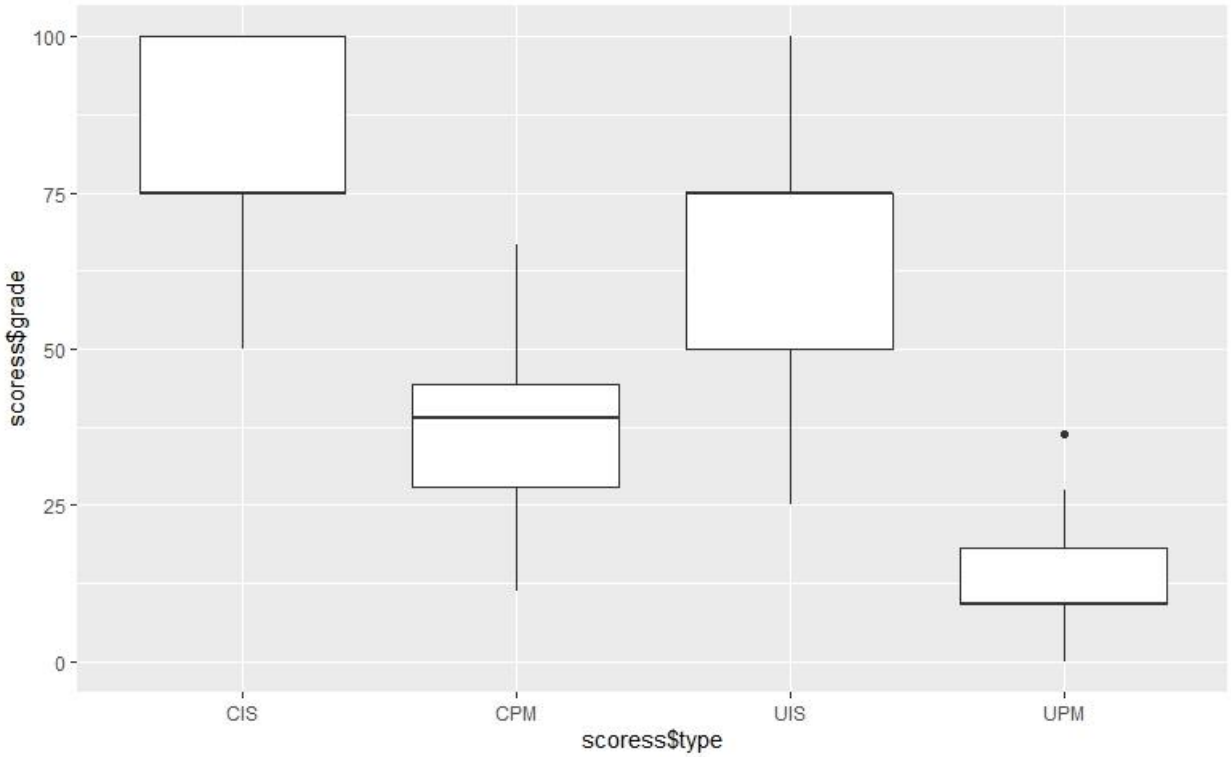

Figure 2.3: Total Score Variation for Canned [A] & Uncanned [B] Ingredient Related and Processing Observations

A- Youtube videos (n=29) are found in Table 2.1
B- Youtube videos (n=21) are found in Table 2.2
*CIS- Canned Ingredient Selection
*CPM- Canned Processing Method
*UIS- Uncanned Ingredient Selection
*UPM- Uncanned Processing Method

2.4.7 Onion Jam

The prepared jam was analyzed for water activity, Brix, and pH content. Three replicates of jam were processed for each recipe. These variables were assessed to determine the variation in the formulation as well as participant execution of instructions. Our results determined that there were no significant ($p > 0.05$) differences between each replicate within each YouTube video recipe (Table 2.8), meaning that each of three independent volunteers produced a similar product. These values for all three characteristics are compared to suggested values in the following discussion. The jams also had very different appearances, as shown in Figure 2.4.

Table 2.8: Onion Jam Analysis for Amateur Level YouTube Videos [A]

Aw			
Replicate	**2LeeLou**	**Linda's Pantry**	**Inside Kate's Kitchen**
1	0.97	0.87	0.98
2	0.97	0.93	0.98
3	0.95	0.92	0.98
Average	0. 96 ± 0.01[a]	0.91 ± 0.04[b]	0.98 ± 0.00[a]

Table 2.8 Continued			
P-value	0.54	0.44	0.51
pH			
Replicate	**2LeeLou**	**Linda's Pantry**	**Inside Kate's Kitchen**
1	3.61	4.07	3.75
2	3.62	3.77	3.66
3	3.56	3.85	3.78
Average	3.60 ± 0.04^{a}	3.89 ± 0.15^{b}	3.73 ± 0.06^{a}
P-value	0.42	0.51	0.84
Brix			
Replicate	**2LeeLou**	**Linda's Pantry**	**Inside Kate's Kitchen**
1	29.83	63.43	18.03
2	27.87	46.97	19.77
3	33.97	50.23	16.53
Average	30.56 ± 3.11^{a}	53.54 ± 8.72^{b}	18.11 ± 1.62^{c}

Table 2.8 Continued			
P-value	0.53	0.45	0.69

A- YouTube videos used (n=3) are found in Table 2.4

Figure 2.4: YouTube [A] Onion Jam Preparations (Right to left: Linda's Pantry, 2Leelou Create's, and Kate's Kitchen) (own photo)

A- YouTube videos used (n=3) are found in Table 2.4

2.5 Discussion

The goal of this study was to examine the presence and effectiveness of safety messages on YouTube and how this translates to a safely produced home-canned savory jam. Available videos were inspected for both positive and negative safety habits, based on canning methodology, ingredient choice, the expertise level of the content creator, and the overall impact of these attributes on a home canner's behaviors. In addition to assessing the messaging of available YouTube videos, recipes were also prepared according to video instruction. To understand the effects of formulation and instruction execution, product specifications, including water activity, Brix, and pH, were also determined. The results of this study can be used by Cooperative Extension specialists to create suitable recommendations for these new media platforms. Additionally, these concepts can be applied to new trending recipes to assist home cooks in developing safe cooking habits and products.

YouTube, a video-based media platform used to share content on a wide range of topics, has been available since 2005 (Rhoades & Ellis, 2010). However, the popularity of using the platform for the development of trending recipe concepts, such as savory jams, has been rapidly increasing (Cooper, 2015). This rapid influx has created challenges for food safety entities to keep up with the impact of uncensored messaging around new product best practices Rhoades & Ellis (2010) previously examined the presence of food safety practices in available YouTube videos. This study focused primarily on the objective factors related to media content, including discussion topics and source information. The researchers from this work found that in order to provide sufficient safety messages, a video should focus on one concept to make sure that critical information is not overlooked by the viewer (Rhoades & Ellis, 2010). This study by Rhoades & Ellis did not provide any analysis of the safety messages that are unspoken like boiling water

height or time adjustment for boiling based on altitude, which is why our study focused on these messages. Viewers watch for these behaviors, make educated guesses, or look up safety information provided by the USDA or NCHFP if those resources are discussed. These two studies demonstrated that content creators are likely not referring to this information, since overall grades were failing for processing practices as well as characteristics of the jam were not meeting standards for the fruit version to compare.

Additionally, their study focused on a single food safety message, whereas in a practical application, a cumulation of best preparation practices is required to produce a safe home-canned product truly. Our study just began to uncover the surface of this topic. It was also suggested that future research is needed to better address the ever-expanding platform content, which is continuously created and uploaded. Our study also suggests the same. Future research and more content are needed for the ever-expanding YouTube platform.

From the fifty videos that were analyzed, unsurprisingly, when one safe habit was exhibited, such as choosing a traditional sugar and not using a sugar replacement or cutting sugar, it is more likely that there will be several additional positive behaviors demonstrated in the video. However, that claim should not be overlooked by the overall grades that these categories received. Ingredient related scores for both uncanned and canned recipes were higher than processing method scores, suggesting fewer issues with ingredient selection than processing method. However, this difference could also be due in part to the smaller size of observations for these categories. The processing method had up to eighteen observations included. Processing methods for both canned and uncanned recipes were given a letter grade of an F, failing grade (below 60%) (CollegeBoard, 2017). Unsurprisingly canned recipes had overall higher scores for demonstration of positive habits, and this is likely because canned products have guidelines for

recipes and are more popular compared to uncanned recipes. As an objective of this study was to evaluate the safety of these recipes, it is discouraging to see that the information provided does not pass the grading procedures or quantitative analysis. This demonstrates the urgency for more research on information provided for recipes on this platform.

In order to establish guidelines for content creators to follow, USDA and NCHFP must create standards for recipes which could be referenced in subsequent recipe development, while also providing additional information in the description box of a video. Previous expectations were that a higher expertise level would result in overall higher positive habits seen, which was borne out in the analysis. For example, in canned recipes of higher expertise that suggested practices like including USDA guidelines ($p < 0.05$) and traditional acid ($p < 0.05$) demonstrated significant relationships which raised the overall grade for a video. If YouTubers stay current with guidelines and practices produced by regulatory services, this may lead to an overall higher percentage of positive habits among videos. The USDA and NCHFP could create a group that stays up to date with uploaded content on jam making. Perhaps a check or seal of approval could be given or linked on the NCHFP website for clearly suggested and validated recipes would allow both more practiced home canners and new home canners to easily distinguish approved recipes from those who could have higher risks associated. One other suggestion is for creators for all recipes beyond jam include resources put out by the FDA on such information as final internal temperatures for meat and poultry.

Onion jam was chosen as the savory jam concept for the quantitative analysis, due to the popularity of videos found in the initial video search as well as widely accessible ingredients. The jams were processed in triplicate by participants to validate results as well as provide comparison amongst available home canner recipes. Specifically, reproducibility by home

canners, in addition to analysis metrics to determine product safety, were assessed. A safe jam would include not only safe practices but safe ingredient choices. These safer choices would include using a traditional sugar source such as brown sugar or sucrose (table sugar) as well as a standardized acidulant, such as bottled lemon juice or a vinegar variety. Possible alterations in recipes because of diet or availability of ingredients could potentially compromise the safety of the home-canned product.

Recipes chosen for this portion of the study were selected because of a variety of ingredients. The first recipe provided by 2leelou Creates utilized balsamic vinegar and a combination of sucrose and maple syrup as sweeteners. 2leelou Creates also included low sugar pectin, juice, and spices (Appendix B). The second recipe provided by Linda's Pantry utilized balsamic and dark brown sugar as well as butter in the jam formulation (Appendix B). The third recipe by Inside Kate's Kitchen used vinegar and sugar in addition to salt and celery seeds (Appendix B).

The final component of variation in the recipes was onion variety. Three different onion varieties were used: white, yellow, and sweet. Both the type of onion as well as ingredient storage conditions can ultimately influence sugar content can vary depending on variety as well as storage conditions (Anonymous, 2018; Sharma et al., 2015). These variations in ingredients can translate to differences in the final canned product. Despite these perceived differences, there were no significant differences amongst replicates for any of the analyses of each recipe, indicating the reproducibility of instructions. Changes in measurement method or subjective cooking length, for example, can yield different attributes in the jam (flavor, color, texture). A limitation for this study was that participants had variations in end yield for jars, which could lead to differences in analysis parameters. For example, if a YouTube recipe calls for six onions

(whole commodity measuring), this could alter the yield and characteristics of the ending jam among home producers who may have purchased smaller than average onions, resulting in a higher Brix in the end product.

High acid canned foods, such as jams, must be at or below a pH of 4.6 in order to meet the standard set by the FDA for acidified foods (21 C.F.R. § 114, 2019). Jams typically vary in the range of 3.50-4.50 for fruit-based jams; however, there is currently no standard pH for savory jam products (Clemson Cooperative Extension, n.d.). This again demonstrates the need for more research and guidelines on this trending condiment. As discussed above, ingredient differences can cause changes in the final product, such as sugar content and pH. White onions have an average pH of 5.37-5.85 compared to yellow onions at 5.32-5.60. Home canners for fruit-based jams generally start with more acidic ingredients such as strawberries with a pH of 3-3.90 (Clemson Cooperative Extension, n.d.). In the selected videos, final jam met the standards of pH below 4.6; however, this is still a relevant topic for concern when changing the main ingredient to something such as bacon, which is more basic. Not following guidelines for pH can lead to the germination of BoNT toxin as well as additional growth of vegetative cells (USDA & National Institute of Food and Agriculture, 2015).

As previously mentioned, there were no significant differences amongst days for each recipe we tested; however, water activity (Aw) values were higher than recommendations for all samples. Water activity, which is the ratio of vapor pressure in the food to vapor pressure of the water helps to determine the likelihood of microorganism growth and assess product shelf life (FDA, 2014). The FDA states that water activity above 0.95 can allow microorganisms and fungi to flourish (FDA, 2014). All the recipes produced jams with Aw above 0.90, and at least one sample with Aw above 0.95. Typically, Aw of 0.85 is the recommended standard for a controlled

product to inhibit bacterial and fungal growth (FDA, 2014: Missouri Dept. of Health and Senior Services Bureau of Environmental Health Services, 2016; USDA & National Institute of Food and Agriculture, 2015). Due to the results of the study, which demonstrated that none of the samples met the 0.85 recommendation, we can see that risks are heightened with these amateur recipes. When not adequately controlled, an increase in water activity increases the chances of food spoilage and foodborne illness, including foodborne intoxications. This can be additionally prevented if jars are processed using tested methods such as water-bath canning for the appropriate time based on altitude or pressure canning (Laborde et al., 2019).

Finally, □Brix indicates the number of soluble solids in a substance and can be used as an additional method for assessing pathogen survival capabilities within a given food medium (Kleinhenz & Bumgarner, 2013). The standard set for the FDA of jam and jellies is a minimum of 65% soluble solids content (21 C.F.R. § 150.160, 2019). None of the samples we tested reached this average Brix threshold. The closest sample to the 65% recommendation was 53% more than 10% below the suggestion. The lowest value for Brix was 18% well below the standard value. Having values drastically below the standard demonstrates not only how much variation in recipes but also heightens the risk that two recipes were all below 65%. In fact, only one of Linda's Pantry samples demonstrated a 65% sugar content. This demonstrates an apparent lack of safety awareness in ingredient selection among YouTubers. We suspect that ingredients are most likely selected based on availability, cost, and taste rather than possible safety implications. Brix and water activity have an inverse relationship; as sugar or solid content increases the water activity decreases. When a home canner can control the sugar content, they would also be indirectly controlling the water activity if the suggested 65% from the jam standard of identity is met. This theory will be evaluated in the following chapter. All of these

factors work together to create a safer, higher quality product. They add extra hurdles to control these factors. Botulinum spores are notoriously known to be harder to kill which means that pH control alone may not be sufficient and extra factors like processing habits are needed to control risk.

A limitation of this study was that there were no expert recipes found for savory jam. This can limit our data collection because although expert recipes were used for savory jam, there are new concerns related to savory that need to be evaluated on an expert level as well. As trending recipes, including savory jam, continually gain popularity, this will give access to researchers to broaden the scope of how expertise related to the quality of safety messages relayed to consumers and home canners alike.

Although these discrepancies may appear innocent to the uninformed home canner, these deviations can have a detrimental effect on product safety if jars are not processed correctly or do not meet the required product standards. Examples of these standards include a product pH below 4.6 to prevent germination of BoNT toxin or Brix content to prevent bacterial growth (USDA & National Institute of Food and Agriculture, 2015). Although this study represents only a small gap in safety information surrounding home canning, it suggests that recommendations made by modern recipe sources omit key product quality and safety attributes, including product Brix and water activity.

2.6 Conclusions

This study analyzed the currently available messaging surrounding home-canned savory jam production across current media platforms as well as to examine how these food safety messages translate into a processed savory jam. Our results demonstrate that the expertise level

of the media source, as well as how closely tested guidelines are followed, can have a significant impact on the quality and prevalence of food safety messages provided to the viewer and that content from qualified sources is extremely limited. Efforts to rectify these deficiencies should focus on how information can be provided to YouTubers and bloggers in regards to trending recipes to ensure quality information is delivered to the audience. Additionally, this study quantified the variability of finished product attributes among three home-canned savory jam recipes. Our results indicated that for the majority of samples, the finished product did not meet the target values and standard of identity to constitute a safe jam product. This study also demonstrated that guidance is needed for savory jam production among home canners. Further research and testing of trending recipes are necessary to illustrate safe practices for home canners and home cooks alike.

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CHAPTER 3

INSPECTION OF RECIPE SOURCING AND HOME CANNING FOOD SAFETY BEHAVIORS

3.1 Abstract

Due to the rise of social media, influencers and celebrity chefs have been able to start trends in recipes for home cooks to use. These trending recipes can change as often as every week. Thousands of recipes available to home cooks are published every day on a variety of media outlets, including YouTube and food blogs. These outlets, however, are not regulated for the quality of their information or how they can influence the habits of the consumers using them.

The goal of this study was to assess the current habits of home canners and to explore how they select and use recipes. These two objectives combine to help evaluate what current practices home-canners are following to reduce food safety risk as well as to inform the creation of quality information in the future for home canners on these new digital platforms. Evaluating how and where home cooks select resources can provide direction for creating content on food safety habits that is both engaging and informative for consumers in regards to trending recipes. A digital survey was distributed to volunteer participants nationwide through email (Appendix C), paper fliers (Appendix D), and social media. A total of 724 responses were included in the subsequent analysis.

The results of this study demonstrate that home-canners are still following some high-risk behaviors, including the use of ill-advised processing methods, often disregarding altitude when processing jars, deviating from recipe instructions, and changing ingredient quantities. These habits are also related to the age of the home-canner, with more experienced canners likely to

utilize qualified resources, like the USDA and NCHFP. Younger aged participants used more social media resources, like Pinterest and blogs, as opposed to the recommended resources. Continually evaluating how and where consumers are sourcing their recipes, and their current food safety practices are valuable strategies in creating media to fit these evolving platforms targeted for the younger population.

3.2 Introduction

Cooperative Extension and The National Center for Home Food Preservation (NCHFP) are at the forefront of developing guidelines on home food preservation. NCHFP provides guides and answers questions for home preservers online. Cooperative Extension offers more localized expertise on canning through phone calls and in-person lessons such as classes with master food preservers.

Although valuable tools, these specialized resources can get lost within the overwhelming amount of internet-based recipe content. These information outlets, including YouTube and blogs, offer amateur home canners recipes that demonstrate little to no consideration of food safety (Morrison & Young, 2019; Rhoades & Ellis, 2010). YouTube, for example, allows content to be published without review, which, in turn, creates gaps for valid information and increases the risk for foodborne illness among home cooks (Yang, 2019). Evidence for the prominence of online platforms for cooking information among the next generation of home canners is illustrated in a recent study conducted by Cooper (2015). The author determined that younger home cooks have generally transitioned to more online forms for cooking information and keep their device on hand while cooking, whereas those over 35 years old are more apt to print a

recipe found on the internet (Cooper, 2015). However, close to 60% of millennials use devices such as smartphones while cooking.

This plethora of available resources and changing platforms of information for the home canner can present challenges in recipe selection and ingredient availability. Adding to the complexity is the rise of viral recipes, innovative foods that spread quickly across the internet. One of them is savory jam, a jam variety that uses a savory main ingredient to combine sweet and savory flavors. The available resources for trending dishes are continually changing, keeping a pace that cannot be matched by experts, which makes finding concrete, reliable recommendations for safely preparing these foods difficult. Savory jam is one such trending commodity and has been gaining popularity among home processors (Gupta, 2016). Unlike sweet jams, there are currently no guidelines for safely producing this condiment.

Currently, there is very little information on the food safety habits of home-canners when processing jam. Additionally, little is known about consumer considerations when selecting a recipe or the sources used in finding such information. This study aims to assess the prevalence of various safe or unsafe habits observed in YouTube videos (Chapter 2) among self-identified home canners in order to demonstrate how these behaviors translate to the consumer. Therefore, the objectives of this study are to (i) evaluate which high-risk habits previously observed in YouTube videos are common to home canners and (ii) assess what factors home cooks utilize to decide on a recipe to use.

3.3 Materials and Methods

3.3.1 IRB Approval

The University of Maine Institutional Review Board for the Protection of Human Subjects approved survey was distributed to home canners in order to assess habits for recipe

selection and food safety practices in the preparation of home-canned jam. The survey, which was constructed and administered using Qualtrics software (Qualtrics, Provo, UT), consisted of 25 questions in total, taking 15-20 minutes to complete (Appendix E). Questions were created based upon results of a previous study quantifying high-risk behaviors seen in savory jam videos on YouTube. An unofficial survey was distributed to multiple Cooperative Extension agents by Kathleen Savoie (Extension Professor and member of the Master Food Preserver Program) to receive feedback on the survey length and questions. Their feedback was incorporated into the final survey instrument. Participants were instructed to read the directions and informed consent (Appendix F) to indicate their willingness to participate in the study.

3.3.2 Participants

The survey was distributed for two weeks in February 2020 using email, paper fliers, notices from the University of Maine Cooperative Extension, social media (Facebook), and in the comments of videos assessed during the previous study. Survey participants were required to be 18 years or older and have internet access. All responses were anonymous, and no identifying information was collected. A total of 724 participants responded to the survey. However, not all participants answered all the questions, as specific responses rerouted the survey questions to be relevant to the specific participant (Appendix E).

3.3.3 Statistical Analysis

Data were analyzed using SPSS (IBM Corp, Armon, NY) for correlations using Spearman's Rho (ρ) between such attributes like age and frequently used recipe sources, the propensity to follow recipes, make substitutions, or adjust ingredient quantities.

3.4 Results

The demographics of survey respondents show that the majority of participants (88.9%) were female (Table 3.1), and 67.4% of participants were also above the age of 46 years. A 2002 study found similar results, with only 24% of respondents being under the age of 35 (Andress et al., 2002). To assess the need for modified processing instructions for areas located above a 1,000 ft elevation, questions about region and altitude were also posed. Regions were classified based on the US Census Bureau designations (Abadi & Kiersz, 2018). The Northeastern region, where 61.3% of respondents resided, is also where the survey originated. The other regions were represented as west (25.7%), midwest (8.44%), and south (4.56%). The majority (76.6%) of respondents reported not living above 1,000 ft; however, 10.5% of respondents did not know whether or not they reside at high elevation.

Table 3.1: Demographics and Pre-Screening of Survey Participants

Indicate Your Gender [A]	Female	88.9%
	Male	9.25%
	Transgender female/trans woman	0.14%
	Transgender male/trans male	0%
	Non-binary, genderqueer, or gender-fluid	0.41%
	Gender identity not listed	0.28%
	Prefer not to answer	0.97%
Indicate Your Age Bracket [B]	18-25	7.60%
	26-35	9.25%

Table 3.1 Continued		
	36-45	14.6%
	46-55	17.7%
	56-65	26.6%
	65 years or older	23.1%
	Prefer not to answer	1.10%
What region do you reside in? [C]	West	25.7%
	Midwest	8.44%
	South	4.56%
	Northeast	61.3%
Do you live at an altitude above 1,000 ft? [D]	Live above 1,000 ft	12.9%
	Does not live above 1,000 ft	76.6%
	Not sure	10.5%

A- n=724
B- n=724
C- n=723
D- n= 723

Questions focusing on familiarity with savory jam were also included in the survey to determine the popularity of this condiment among participants. The majority of participants (76.9%) reported that they are familiar with the product and of those familiar with savory jam 54.9% of respondents reported having made a jam flavor that would qualify as savory (Table 3.2), but older respondents were less likely (p= 0.012) to be familiar with this condiment. Several

questions focused on compliance with commonly recommended, food safety-related behaviors. One question, for example (Figure 3.1), asked participants if they wash their hands before and after handling raw food. Most participants (83%) reported always cleaning hands when handling food (Figure 3.1). Most respondents, 83.2% (601 participants), also reported that they have previously canned jam at home. There were many variations seen in jams made at home shown in Figure 3.2 including multiple flavors of savory jam.

Table 3.2: Evaluation of Savory Jam Familiarity

Savory Jam Familiarity [A]	Familiar with savory jam	76.9%
	Unfamiliar with savory jam	21.4%
	Not sure	1.66%
Have you ever made jam at home? [B]	Yes	83.2%
	No	16.9%
Participants familiar with savory jam and have made savory jam as well [C,D] ?	Familiar and have made savory jam	54.9
	Familiar but have NOT made savory jam	45.1%

A- n=724
B- n= 724
C- n= 475
D- savory jam varieties included in this count included bacon, onion, tomato, and chili pepper varieties

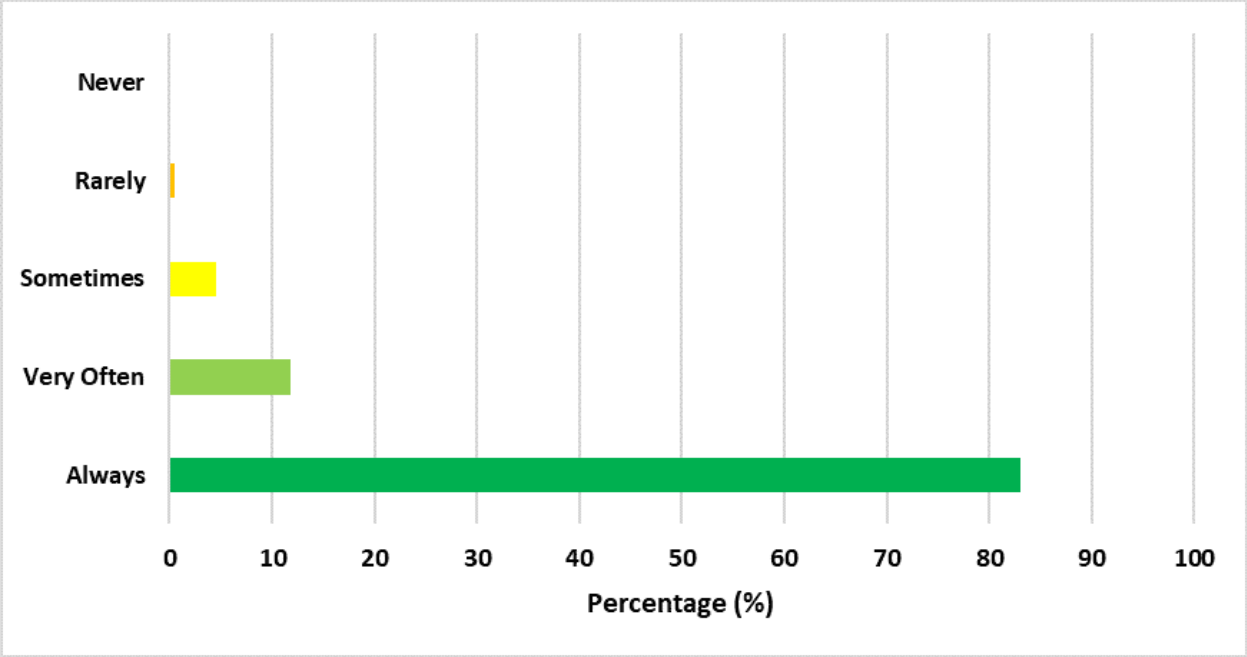

Figure 3.1: Evaluation [A] of Hand Washing Habits of Survey Participants [B]
A- Question phrased as 'Do you wash your hands before and after handling raw food?'
B- n= 719

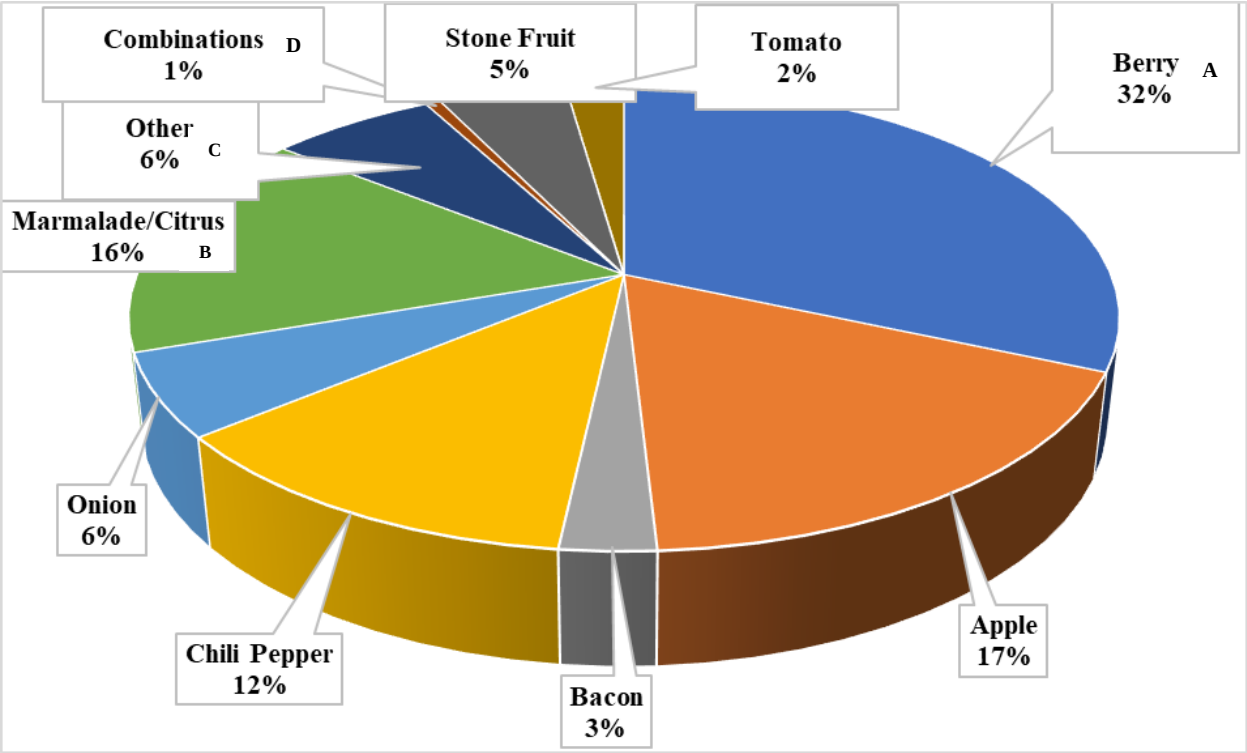

Figure 3.2: Jam Variations Prepared by Home Canners [F]

A- Berry jams included the following blackberry, mulberry, raspberry, elderberry, blackberry, strawberry, blueberry, and cranberry.
B- Marmalade/citrus varieties included kumquats, nectarine, lemons, and other citrus varieties not specified.
C- Other variety includes the following-- fig, herbs, carrots, rosehips, frejoia, wine, date, lavender, dandelion, floral, pumpkin, pineapple, pear, grape, ginger, pomegranate, kiwi, passionfruit, watermelon, etc.
D- Combinations included--strawberry-rhubarb, lemon ginger, zucchini-maple, pineapple-rhubarb, tomato-garlic, lemon-ginger, peach-bourbon, ginger-peach, fig-balsamic vinegar, and other combinations not specified.
E- Stone fruit included peach, pluot, sour cherry, nectarine, plum, chokecherry, mango, apricot, cherry, peach bourbon, peach plum, and Sandhill plum.
F- n= 602

Most participants reported that they follow recipes (Figure 3.3) for guidance when making jam. Older participants were more likely to follow a recipe (p= 0.028). Only 29.2% of participants never make substitutions to recipes (Figure 3.4). In assessing the types of modifications that home canners are making to chosen recipes, we asked if substitutions for salt and sugar were made. Responses to this question were widely variable, with only 35.3% of participants indicating that they never change salt and sugar measurements, again with older respondents less likely to make such changes. However, 12.9% of the participants reported that they very often make changes to these ingredients.

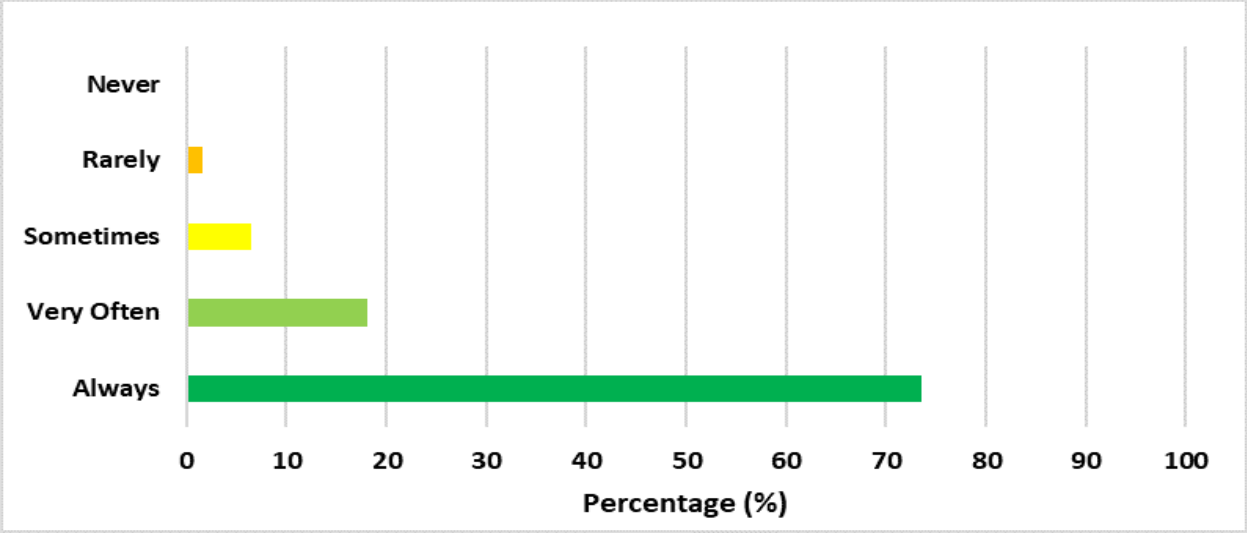

Figure 3.3: Evaluation [A] of Home-Canner [B] Likelihood to Follow Jam Recipe

A- Question phrased as ‘Do you follow a recipe when making jam?’
B- n= 601

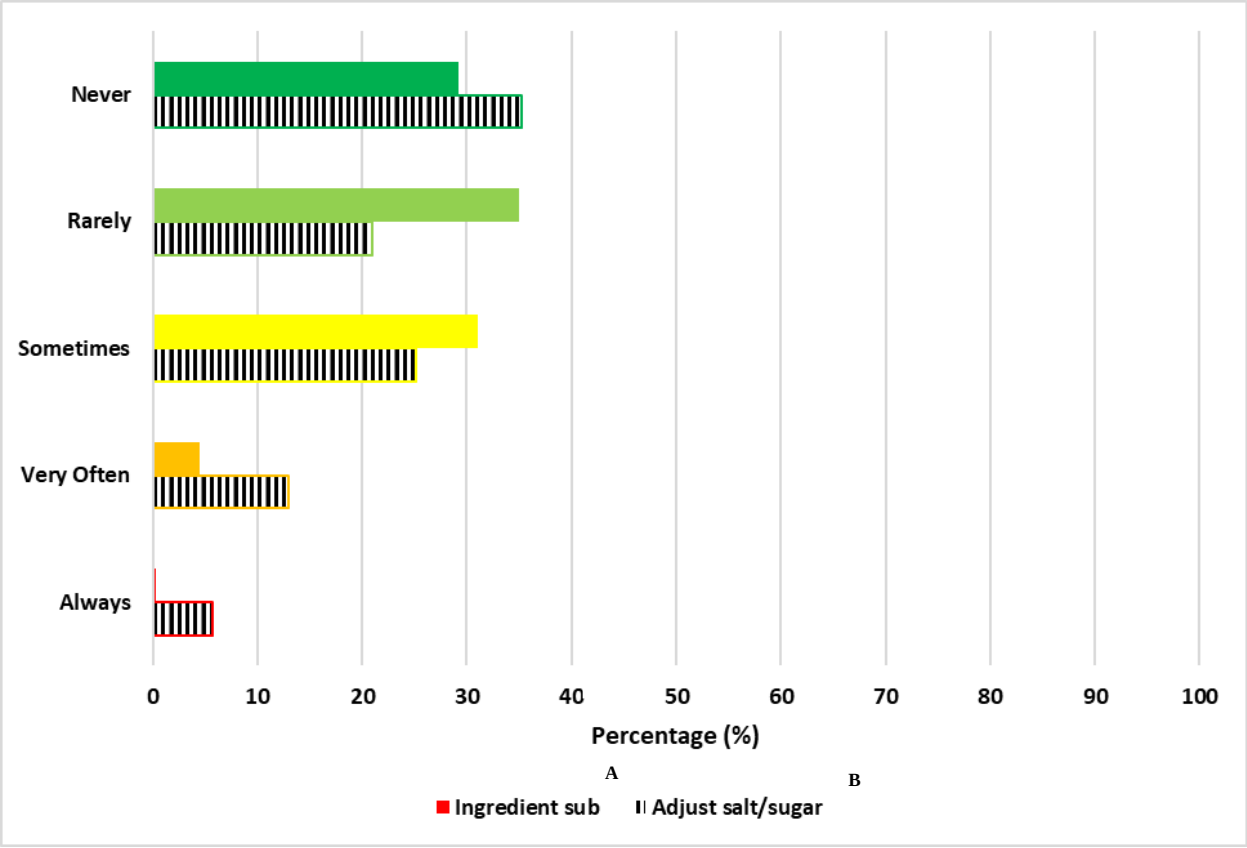

Figure 3.4: Evaluation of Home-Canners Likelihood to Make Changes in Ingredients for Jam Recipe
A- Question phrased as, ‘Do you make ingredient substitutions when using a jam recipe?’, n= 600
B- Question phrased as, ‘When making jam, do you adjust ingredients such as sugar or salt to suit your preferences (taste or nutrition)?’, n= 601

Participant processing habits were also evaluated (Figures 3.5- 3.8). Although participants were only able to select one processing method, the majority of respondents (85.5%) reported that they utilize water bath canning, followed by non-processed jam (5.83%), inversion (4.49%), and pressure canning (3.49%) (Figure 3.5). Continuing with clean habits used when handling ingredients demonstrated that 84.2% of participants wash produce before making jam.

Statistics demonstrated that increased age was correlated with a higher likelihood of washing produce ($p < 0.0010$) (Figure 3.6).

Home canners that exclusively use water baths for processing were asked if they consider their altitude when processing jars. Results for this question showed an almost equal divide—44.1% of the home canners always consider their altitude when boiling jars; on the other hand, 44.3% of home canners never consider their altitude (Figure 3.7 & Table 3.3) The final processing-related habit assessed for home canners was the measurement of headspace in jars, with most home canners (63.6%) reporting that they always measure headspace (Figure 3.8). There was an association between age and the measuring of headspace ($p= 0.032$), again demonstrating that older participants are more likely to measure headspace while processing.

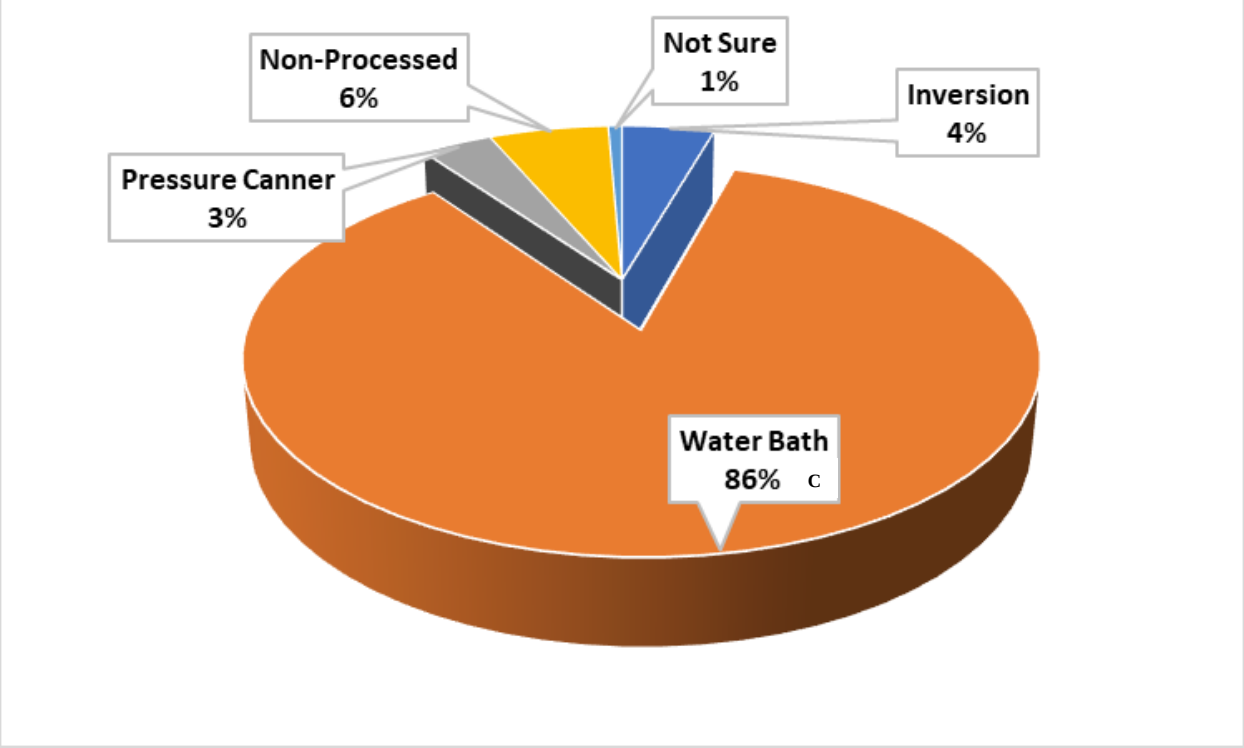

Figure 3.5: Processing Related Habits [A] Exhibited by Home-Canning Participants [B]

A- Question phrased as 'What method do you use to process your jars at home?'
B- n=601, participants who use more than one processing method were instructed to choose what method they use most often

C- Steam canning was included in this category

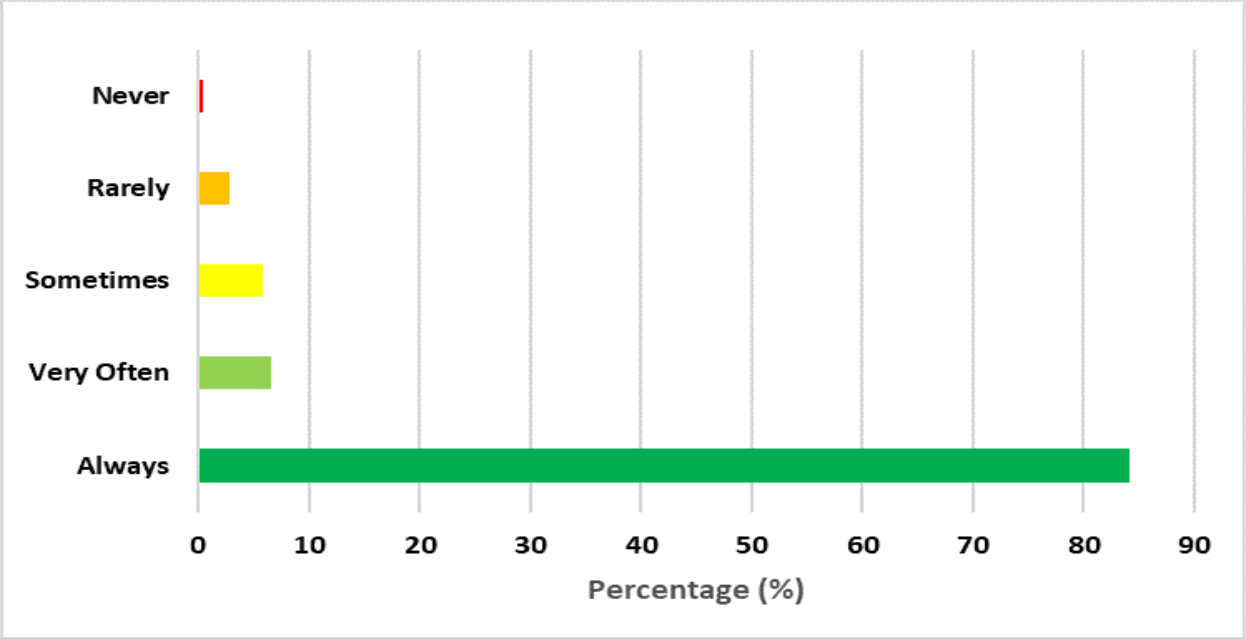

Figure 3.6: Evaluation of Home Canners [A] Habits for Washing Produce Before Making Jam
A- Question phrased as 'Do you wash your produce before making jam?'
B- n= 601

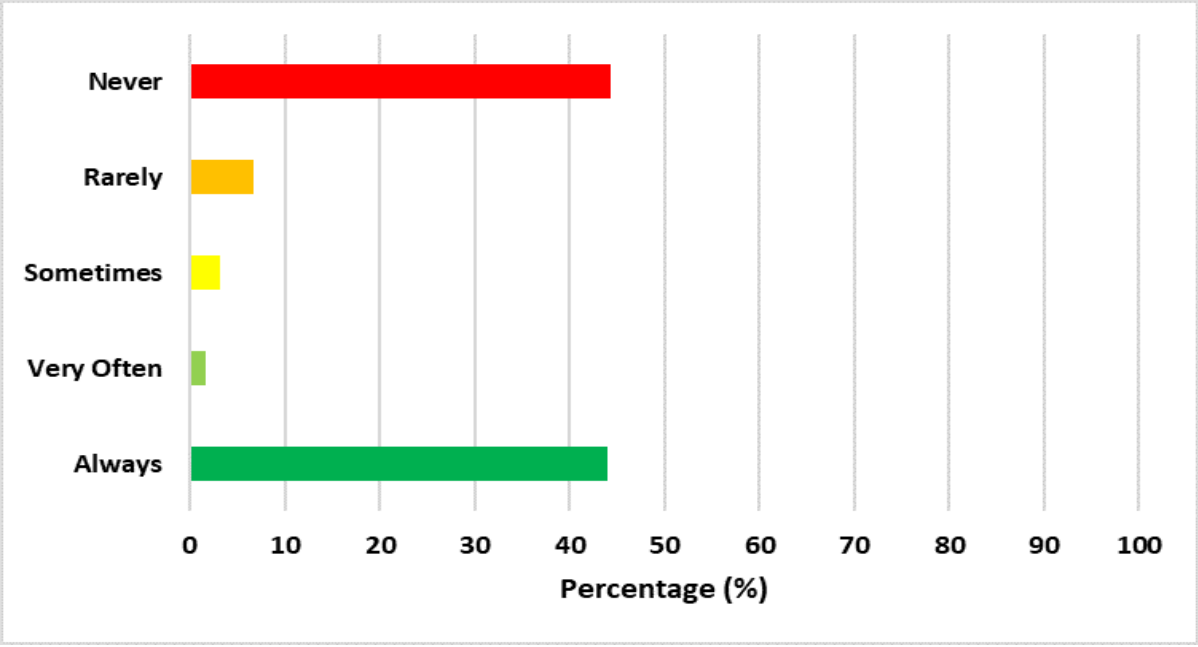

Figure 3.7: Evaluation of Participants [A] to Consider Altitude when Processing Jars

A- n= 533

Table 3.3: Evaluation of Relationship Between altitude of Participants and Considering Altitude

Response	At or above 1,00 ft [A]	Below 1,000 [B]	Not Sure [C]
Always	60	174	1
Very Often	3	6	0
Sometimes	1	12	4
Rarely	5	26	5
Never	8	199	29

A- n= 77
B- n= 417
C- n= 39

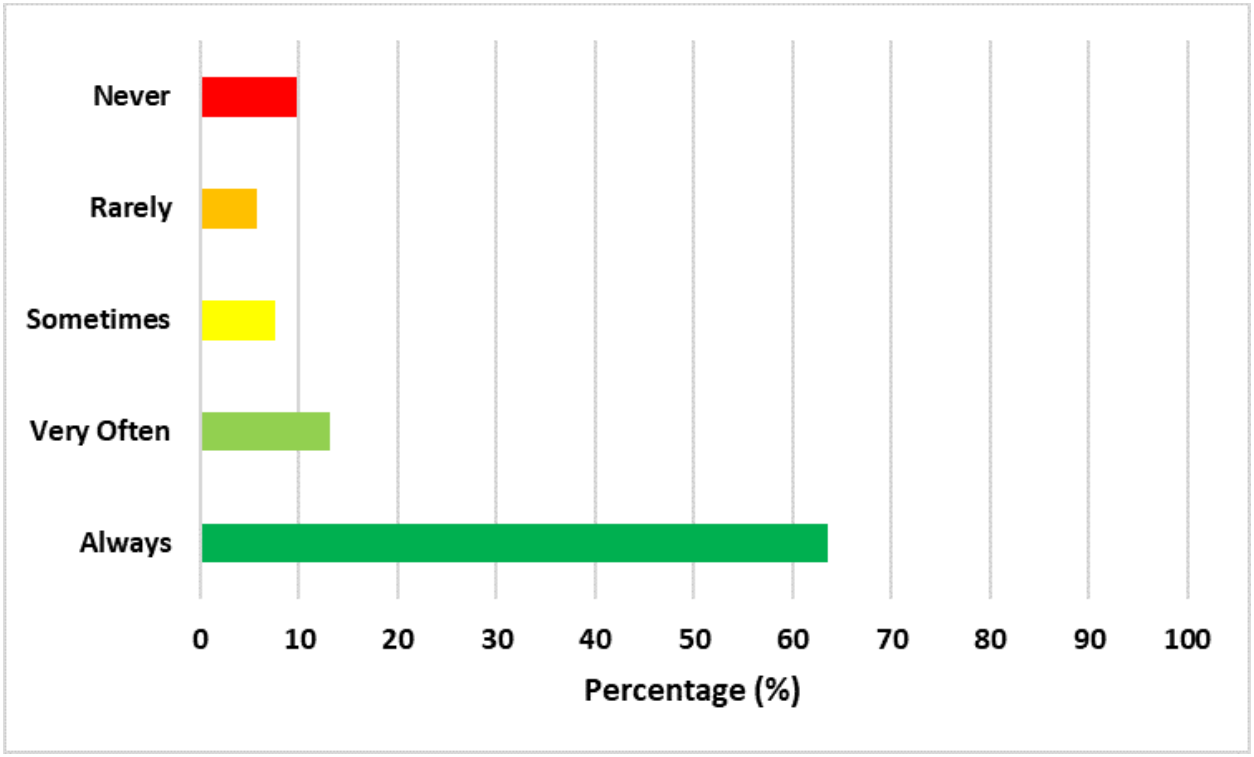

Figure 3.8: Evaluation of Participants [A] to Consider Headspace When Prepare to Process Jars
A- n= 561

Post-processing habits were assessed exclusively for home canners (Table 3.4 & Figure 3.9). Responses from any participants that reported not having canned jam at home were removed from the dataset before analysis. Our results indicate that most home canners (67.6%) keep their processed jars for more than one year. When participants were asked if they had ever had a jar that did not seal properly, 81.1% of participants reported a jar had been improperly sealed, with younger participants more likely ($p=0.003$) to report sealing issues. Among home canners who reported experiencing improper container sealing (n= 454), an assessment of corrective actions, if any, were then evaluated. The majority of respondents indicated that jars with improper seals were stored in the refrigerator (73.8%), followed by throwing the jar out (16.1%), resealing (6.83%), storing in the freezer (2.42%), and finally storing at room temperature (0.89%).

Home canners were then asked if they have had a jar that has spoiled, of which only 17.4% (n=601) responded, "yes." Those participants who answered yes to a spoiled jar were then instructed to select all of the signs of spoilage they observed. The most frequently reported spoilage indicators were mold (76.7%) and color change (40.8%) followed by a foul smell (15.5%), strange texture (13.6%), fizzing (11.7%), off-flavor (11.7%), other (11.7%), and jar breaking (9.70%). Labeling the contents of jars was a habit that most participants (74.6%) recorded as always performing. Older participants were more likely to report that they label jars ($p < 0.001$).

Table 3.4: Post-Processing Habits Exhibited by Home Canning Participants

How long do you keep your sealed home-canned jam? [A]	0-30 Days	0.54%
	1 Month- 6 Months	3.75%
	6 Months- 1 Year	27.1%
	1-2 Years	47.3%
	Over 2 Years	20.3%
	Not Sure	0.89%
Have you ever had a jar that did not seal properly? [B]	Yes	81.1%
	No	17.1%
	Not Sure	1.78%
Has one of your home-canned jams ever spoiled? [C]	Yes	17.3%
	No	78%
	Not Sure	4.66%
How do you store your jars after filling? [D]	Shelf Stable (Cabinet)	92.8%
	Refrigerator	4.69%
	Freezer	2.51%

A- n=560
B- n=562
C- n= 601
D- n= 597

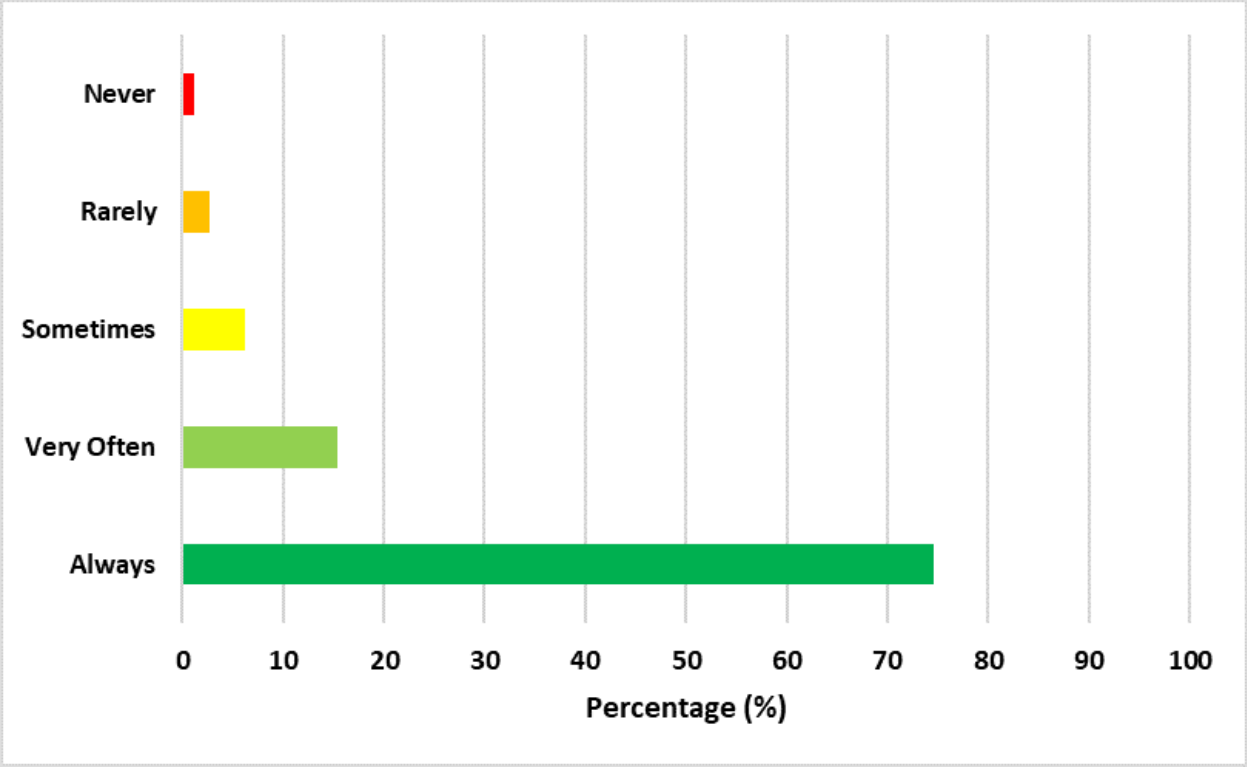

Figure 3.9: Evaluation of Participants [A] Likelihood to Label Jars with Contents and Date of Processing
A- n= 598

Home canners were also asked to indicate all sources that are used to answer questions regarding home canning (Table 3.5). The two most frequently reported options for recipe sources were Cooperative Extension and government sites (NCHFP). The least common resources reported for answering questions were social media and family/friends.

Table 3.5: Sources used by Home Canners for Home Canning Questions

If you had questions on canning, where would you look for an answer? [A]	Cooperative Extension	24.1%
	Family/Friends	8.30%
	Government Site (NCHFP)	21.3%
	Manufacturer of Jar	14.9%

Table 3.5 Continued		
	No Questions on Canning	0.50%
	Recipe You are Using	11.9%
	Search Engine	13.6%
	Social Media (Facebook Group, Reddit, Etc.)	5.50%

A- n= 600, select all that apply

An additional aim of this study was also to determine which resources for recipe selection and consideration among all survey participants are most commonly utilized (Table 3.6). The top four resources (Figure 3.10) for participants were cookbooks (25.5%), government website (16.3%), and a search engine online (11.85%), and family/friends (11.2%). Canning at home was not associated with a higher likelihood of using government websites for recipes ($p < 0.001$). Younger participants overall were more likely to use newer resources like Pinterest and search engines, than government sites. When assessing considerations for recipe selection, surprisingly, no respondents selected views or subscribers count as factors that they consider when selecting a recipe. In contrast, the most popular considerations were ingredients (27.9%), recognition/familiarity with the source (17.8%), and rating of the recipe (10.9%).

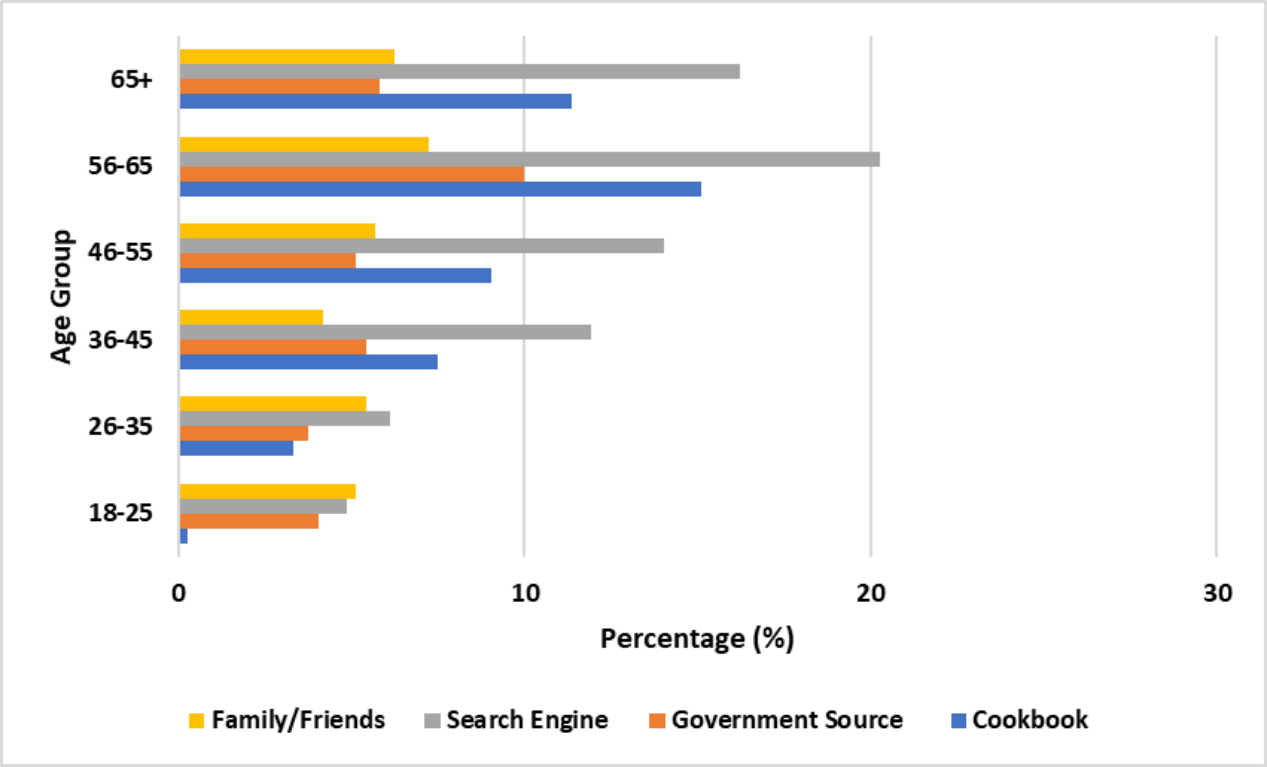

Figure 3.10: Evaluation of Participants [A] Recipe Sourcing Choices For Top 4 Sources
A- n=721

Table 3.6: Recipe Sourcing Choices Made by All Survey Participants

Where do you usually find your recipes? [A]	Cookbooks	25.5%
	Family/Friends	11.2%
	Food Blog	7.90%
	Government Site (NCHFP)	16.3%
	Magazine/Newspaper	6.10%
	Other	8%
	Pinterest	4.90%

Table 3.6 Continued		
	Search Engine (Google, Bing, Etc.)	11.8%
	Social Media	4.80%
	Television	0.80%
	YouTube	2.60%
How do you decide what recipe to use when online searching [B]?	Comments	7.80%
	Complexity	9.30%
	Ingredients	27.9%
	Likes	2.30%
	Other	7.80%
	Photos	7.80%
	Rating	10.9%
	Recognition/Familiarity of Source	17.8%
	Relevance	8.33%
	Subscriber Count	0%
	View Count	0%

A- n= 721, select all that apply
B- n= 66, select all that apply

3.5 Discussion

The goal of this study was to examine the habits and current practices of home canners, as well as to evaluate what resources and considerations are made when sourcing recipes. Home canning habits were examined to determine the extent to which home canners were following safe procedures when processing jam, and how these habits are correlated with demographics and other safe/unsafe behaviors. These relationships can aid in creating more informative and engaging content for home canners.

General practices by study participants, including handwashing before and after handling raw food, were evaluated as well as washing of produce by home canners. More than 80% of participating home canners reported consistent hand and produce washing. Interestingly, this survey was administered prior to the COVID-19 pandemic, in which constant emphasis on handwashing is stressed throughout various media platforms (CDC, 2019; Corcoran, 2020). This increased messaging surrounding the importance of washing hands could further increase the frequency of these practices should the survey be repeated. Compliance with such practices would presumably decrease the occurrence of potential pathogens associated with dirty hands and handling raw food, including *Salmonella*, *E. Coli,* and *Staphylococcus aureus* (CDC, 2019a).

Participants in the survey were asked about recipe following habits and their willingness to incorporate modifications such as ingredient substitutions or adjust ingredient amounts. Our results indicate that a large proportion of participants adjust critical ingredients such as sugar and salt. These changes can increase the likelihood of spoilage and foodborne illness (Kendall, 2012). These ingredients help the food reach a stable state of the water in the product; not using standards for products can increase water activity, which can create a higher moisture

environment that allows pathogens to flourish with growth (Parish, 2006). For these reasons, a standard of identity was established for commercial jams to contain 65% soluble solids (Kleinhenz & Bumgarner, 2013; 21 C.F.R. § 150.160, 2019). Beyond food safety considerations, sugar and salt are also added to improve sensory appeal, including flavor, texture, and color attributes (Kendall, 2012). The safety implications of adjusting sugar and/or salt could be compared to changing ingredients, like using a non-traditional sugar like maple syrup or honey commonly overlooked in YouTube recipe videos for canned jams (reference Chapter 2). As this appears to be a prevalent behavior, it would be a logical focus for future educational efforts. Home canners also reported using water bath processing most often when making jam. This is a recommended methodology for canning proposed by the NCHFP for acid foods and jam. Water bath canning is likely to be the most popular method for canning because of the ease of processing. Aside from a large pot, no additional equipment is required, making it widely accessible to most home canners. Despite the ease of this methodology, there are still considerable safety concerns as the safety of the resulting product is highly dependent on the pH and water activity of the product and the proper timing of the heat treatment. A surprisingly high percentage (44.3%) of respondents indicated that they never consider altitude when boiling jars. Because the temperature of a boiling water bath is effectively lower at high elevation, the time of treatment must be extended to exert an equivalent total treatment. Under processing increases the risk for botulism (USDA & National Institute of Food and Agriculture, 2015). Possible explanations of why this factor is often not considered among home canners are because they may be unaware that they are processing in a high-altitude environment or may not be aware of the need to adjust processing time because the recipe does not indicate this consideration.

Even though there are critical considerations for implementing the water bath methodology, even more concerning is that nearly 5% of respondents also indicated that they utilize inversion canning, which is currently a rejected processing method (USDA & National Institute of Food and Agriculture, 2015). Inversion canning is not recommended because it can create weak seals that can allow oxygen to enter the jar, allowing contaminants, including fungi and bacteria, to enter and cause spoilage (Andress, 2019).

Regardless of which processing method is selected, additional safety-based practices must also be considered. Currently, a ¼ inch headspace in jars is recommended for jams and jellies. This recommendation is to ensure that food does not expand past the capacity of the jar during processing, and a vacuum seal has been created (Clemson Cooperative Extension, n.d.). If the headspace recommendation is not followed, food could escape the container because of a weak seal created or discolor from excess oxygen due to improper vacuum seal (Clemson Cooperative Extension, n.d.). However, despite this standard, nearly 40% of respondents indicate that they do not measure container headspace during the canning of jam.

Jar storage is an additional consideration among home canners. The current recommendation is that properly processed jars should be held in a cool, dry place and used within one year before opening, however, if substitutions or decreased amounts of sugar are included, this can shorten the shelf life of the jam (Anonymous, n.d.). Most respondents reported that they also keep jars for at least a year.

The absence of these best practices can consequently result in product spoilage. In fact, several respondents indicated that they had observed improperly sealed jars. This spoilage could be attributed to recipe modifications made by the home canner or failure to achieve proper sealing. This concern is reflected in the negative correlation between following a recipe and

having a jar spoil that was observed in our study. Among respondents who have observed jar spoilage, reported fizzing, discoloration, foul smell, and jar breaking as spoilage indicators. All the described defects are consistent with *C. botulinum* contamination (CDC, 2018). Participants were not asked what actions they have taken with spoiled jars. If these habits were analyzed, this could allow us to evaluate whether home canners are minimizing risk by throwing away the jar if signs of spoilage are seen.

A 2002 study published by NCHFP collected data on the practices of 501 home canners (Andress et al., 2002). Although the study focused on several commodities beyond jams, the findings of this work are an interesting contrast to our results. When the source of canning instructions was evaluated, 49% of participants recorded that friends and relatives were their top source. In comparison, the least utilized sources were Cooperative Extension (3%) and USDA publications (3%) (Andress et al., 2002). In our study, however, home canners utilized government websites and Cooperative Extension much more often (21.3% and 24.1%, respectively). This is likely a consequence of the fact that a primary method of survey distribution in our study was through established Cooperative Extension networks.

Results can also be specific to age groups. Our results indicated that newer resources for recipes were more likely to be used by younger participants. This can exemplify the widespread use of the internet and more access to tested and qualified recipes for home cooks. The previous study published by NCHFP is now eighteen years old, home canning practices have since changed dramatically due to the internet being increasingly widespread.

Social media usage has continued to rise dramatically; in 2011, close to half of Americans used social media; today, that number is closer to 75% (Anonymous, 2019). A 2005 study determined that social media was used by just 5% of adults (18 years or older) in the

United States (Anonymous, 2019). In 2019, these numbers had drastically increased to 72% of adults using social media (Anonymous, 2019). The emergence of newer platforms such as YouTube is rising for a wide range of purposes beyond entertainment. As a result, these less established resources are increasingly more frequently utilized by home canners. Currently, over 90% of millennials use YouTube, whereas only 38% of the total population reports using this platform (Anonymous, 2019). In our survey, only 2.6% of respondents use YouTube for recipe sourcing. This is likely because of the higher age of our participants, over half (67.4%) of the respondents were over the age of 46. When we look at respondents in differing age groups (18-25 and 46-55) reported usage of YouTube decreased from 32.7% to 3.90%, respectively. Our findings indicate that most of today's home canners are in an older age demographic, which may have influenced our results regarding the popularity of various platforms for recipe sourcing.

Older adults may have a delayed introduction to these platforms because of how fast technology changes. Once a new platform is introduced, the newest generation is often attracted to it, while the older generations lag in their introduction (Cox, 2019). This also works in the opposite direction; an older platform is more popular with older generations and less with the newer generation, who quickly move on to subsequently introduced platforms. Thirty-six percent of Generation-Z and 96% of Baby Boomers, the oldest demographic assessed in this study, reported using Facebook once a week (Cox, 2019) whereas 89% of Generation-Z but only 52% of Baby Boomers use YouTube, and more recently launched media platform, once a week (Cox, 2019). This trend will continue over time, as Generation-Z finds a new outlet, Baby-Boomers will continue to utilize the older platform. Millennials, for example, are using social media and YouTube while cooking (Delgado et al., 2014). As a result, we can suspect that our survey results may also be less representative among future generations, as media sources

continue to be modified. Therefore, determining the reasons behind specific source utilization will be beneficial for establishing long term recommendations targeting specific platforms.

The age of the home canner is also essential to understanding varieties of jams that are most often selected. Savory jam showed more familiarity among younger populations, indicating that younger generations are more familiar with trending recipes, likely due to the increased utilization of social media. Recently, trending recipes such as banana bread are on the rise because of popular YouTubers, celebrities, and social media influencers posting recipes and videos of this food (Smith, 2020). These trending recipes searched by home cooks can change very frequently, which indicates that the amount of content may be overwhelming for consumers to choose a single video source. During the COVID-19 pandemic, individuals are using their devices more, which means the consumption of content is also increasing (Smith, 2019). These creators are making new content daily, while the same cannot be said for expert sources of information such as NCHFP and Cooperative Extension. Consumers and home canners alike should have access to qualified and informative recipes that result in safe end products.

Recently a guideline for recipe developers has been introduced called "Safe Recipe Style Guide," which provides advice to content creators to include quick information on increased safety practices regarding temperature, handwashing, cross-contamination, and produce handling (Partnership for Food Safety Education, 2019). It is unlikely that this resource is frequently used, especially with younger creators. This is because, as suggested, younger home cooks are using newer platforms like Pinterest and blogs as opposed to printed material like cookbooks, but correctly publicizing such resources could significantly increase their use.

Our findings suggest that there are several practices commonly employed by home canners, such as deviation in sugar and salt recommendations, that should be the target of future

educational efforts. Our previous research has indicated that there is an apparent need to examine how new media platforms interact and affect consumers' habits, as several of the same habits were commonly demonstrated on these platforms. Obtaining this data will help to create better content that is safer for consumers. Food safety specialists are presented with increased challenges to develop materials that are wide-reaching to both newer and experienced home canners alike. Regardless of which platforms are selected by home canners, the absence of standard safety practices, including routine handwashing, jar headspace validation, and canning method selection, presents obvious consumer safety concerns.

3.6 Conclusion

This study evaluated current home canner habits and the home cook's recipe selection process. Understanding these practices is necessary for developing content that contains the best approaches for spreading awareness of safe behaviors. This information is also beneficial in determining why and which media platforms consumers are choosing to select recipes. With such knowledge, researchers and experts may better understand how new platforms like social media and YouTube affect consumers and how to better direct the distribution of educational materials to creators and users on these platforms. Our results, compared to a previous study on home canning habits, demonstrates the evolution of common practices as a result of the increasing information and resources that are available. The abundance of internet resources can make choosing a recipe overwhelming for a consumer or new home canner, who may be unaware of common safety concerns. As a result, these groups are more inclined to choose the first recipe they find or the most popular recipe, instead of selecting a recipe which has been validated by food safety specialists. Although this research is in reference to savory jam, a

commodity that currently lacks food safety guidelines, these learnings are applicable to all products prepared at home.

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APPENDIX A: INSTRUCTIONS FOR SAVORY JAM PARTICIPANTS

You will be asked to come in three times to make onion jam.

We ask that you watch your recipe video first without starting to cook. You are welcome to pause and write down notes on a sheet of paper, this paper will be collected at the end of each jam making day. You are not required to wear gloves; however, if you would typically wear gloves when making jam at home, you are welcome to ask for them to be provided.

After watching the video the first time, you are then able to start making jam. Again, you are welcome to take notes and pause the video as many times as you would like. Please do not consult with others on recipes or instructions. We will have a variety of measuring vessels available; you can use the vessel you would use while making jam or the one used in the video. If, for example, specific cooking times are used, please follow those instructions. If there are subjective cooking instructions such as cook until soft, please write down how long cooking was based on your subjective observations.

If there are any questions or concerns that you come across while making the jam, we ask that you please write those down. If information is not provided for part of the recipe you feel should have been included, please write that down as well. Finally, if any instructions are missing in the video, please be assertive and do what you would do if you were at home making these recipes.

APPENDIX B: TRANSCRIBED RECIPES

Transcribed recipes were not given to savory jam participants.

2Leelou Creates

- Yield: 5 half-pint jars
- Ingredients
    - ½ cup maple syrup
    - 1.5 teaspoons of salt
    - 2 teaspoons of ground white pepper
    - 1 bay leaf
    - 2 cups of apple juice
    - ½ cup balsamic vinegar
    - 3 tablespoons of Ball low or no sugar pectin
    - ½ cup of sugar
    - 2 lbs. of chopped onions (white onions used)
- Instructions
    - Wash jars and measure all ingredients out. Weigh two pounds of chopped onions on a scale. Onions, balsamic vinegar, maple syrup, salt, ground white pepper, and bay leaf into pot. Place pot on the stove over medium heat. Meanwhile, jars are in hot water. Made note that jars are processed for fifteen minutes, so jars do not need to be pre-sterilized. They are cooking on the stove for 15 minutes until onions are translucent. Apple juice and pectin are added to the pot. Heat turned up to a full rolling boil that cannot be stirred down. Add in sugar and stir to dissolve. Bring the mixture back to rolling boil and boil for one minute. Remove and

discard bay leaf and skim the foam off the top of the mixture. Jars then filled using a funnel and filled to ¼ in from the top. Wipe down the top of the jar with a paper towel. Use magnet gadget to attach lid that was sitting in water. The ring is placed on top of the jar until fingertip tight—process for 15 minutes with 1 to 2 inches of water above the jars. Bring the water to a full boil and wait 15 minutes. Take the lid off and let the jars sit for 5 minutes then take them out.

Linda's Pantry

- Yield: 7 half-pints
- Ingredients
    - 8 onions (1 sweet onion, 7 yellow onions)
    - 3 ½ cups dark brown sugar
    - 2 ¼ cups of balsamic vinegar
    - ½ cup of butter
    - 1 ½ teaspoon of salt
- Instructions
    - In an electric skillet, place ½ cup of butter. Meanwhile, chop onions used Vidalia chop wizard. 20 cups of chopped onions added to the skillet with butter. With the skillet on medium to medium-high heat sweat onions down. Add 1 ½ teaspoon of salt to help sweat them down. Caramelize the onions for 1 hour and 15 minutes. Add in balsamic vinegar and dark brown sugar. Makes note that if too sweet, subject to change, taste, and adjust as needed. Also, it mentions how you could add pectin or cornstarch slurry if you want. Reduce the heat and simmer for 15

minutes. Grabs hot jar in hot water from sink and rings/tops are in hot water as well. Use a ladle and fill the hot jar with jam mixture to ¼ for the headspace. Use a napkin with white vinegar to wipe the top of the jar and inspect the top for knicks. The jar should be as clean as possible, place in dishwasher or hot soapy water for water bath canning. Jars placed into boiling water for 10 minutes, turn off the heat for 5 minutes, then take the jars out as soon as lid sinks down, good to go. Shelf life is best in a cool dark place, best if used in a year.

Inside Kate's Kitchen

- Yield: not specified
- Ingredients
    - 5 lbs. or 10 cups of onions
    - 2 tablespoons of celery seeds
    - 1 cup of sugar
    - 2 ¼ cup of white vinegar
    - 2 tablespoons of non-iodized salt
- Instructions
    - Start by chopping your onion. In a large pot, add onions, sugar, salt, celery seeds, and vinegar. Put it on the stove for 20-25 minutes; they should not be caramelized but soft. When starting the cooking process start on high, bring the mixture to a boil while you are stirring, then bring the heat down to medium and simmer for 10-15 minutes. Jars are in simmering water. Take the jar and dump out the water. Using a funnel and ladle, fill the jars with 1 for the headspace. Use a debubbler to

get rid of air pockets. Use a clean paper towel and vinegar to wipe down the top of the jar. Place the lid on and tighten the top. Place into the canner with hot water. When the pot is full cover with the lid and turn it up to a boil. When it is boiling, time 15 minutes, then turn off heat and cool in the pot for 10 minutes. Wait 24 hours for the vacuum seal top to be concave. Take the rings off, label jars, and put it into your pantry.

APPENDIX C: JAM SURVEY EMAIL FLYER

Participation needed for a brief online survey on recipe selection and habits for home-canning jam.

Greetings-- You are receiving this email because you are in the email list of (School of Food and Agriculture…(https://umaine.qualtrics.com/jfe/form/SV_066k2ktE8Zjfxyd)

You are invited to participate in a research project conducted by graduate student Alison Brodt and faculty sponsor Dr. Jennifer Perry of the University of Maine School of Food and Agriculture. If you are 18 years or older, have internet access, and make jam at home, please help researchers learn about how home canners choose recipes for jam and the food safety habits they perform in the kitchen.

This study should take 15 minutes to complete. All responses are anonymous. The data files will be archived in Digital Commons and kept indefinitely so that other researchers may access the data.

If you have any questions, please contact Alison Brodt at alison.brodt@maine.edu or Dr. Jennifer Perry (faculty sponsor) at jennifer.perry@maine.edu.

APPENDIX D: JAM SURVEY PAPER FLYER

Participation needed for a brief online survey on recipe selection and home-canning practices for jam.

Hello--

You are invited to participate in a research project conducted by graduate student Alison Brodt and faculty sponsor Dr. Jennifer Perry of the University of Maine School of Food and Agriculture. If you are at least 18 years old, have internet access, please help these researchers learn about the process of recipe selection for home-canners and the habits they have when home-canning jam.

This study should take no more than 15 minutes to complete. All responses are anonymous.

Link for the survey: https://umaine.qualtrics.com/jfe/form/SV_066k2ktE8Zjfxyd

QR code for survey:

If you have any questions, please contact Alison Brodt at alison.brodt@maine.edu or Dr. Jennifer Perry (faculty sponsor) at jennifer.perry@maine.edu

APPENDIX E: JAM SURVEY QUESTIONNAIRE

1. Please indicate your gender. (Choose one answer)
    - Male
    - Female
    - Transgender female/trans woman (or Male-to-Female (MTF) transgender, transsexual, or on the trans female spectrum)
    - Transgender male/trans male (or Female-to-Male (FTM) transgender, transsexual, or on the trans male spectrum)
    - Non-binary, genderqueer, or genderfluid
    - Gender identity not listed
    - Prefer not to answer
2. Please indicate your age bracket based on your last birthday. (Choose one answer)
    - 18-25
    - 26-35
    - 36-45
    - 46-55
    - 56-65
    - 66 years or older
    - Prefer not to answer
3. What region of the U.S. do you live in?
    - West
    - Midwest
    - South
    - Northeast
4. Do you live at an altitude above 1,000 ft?
    - Yes
    - No
    - Not sure
5. Savory jam is a sweet and salty jam with a savory main ingredient such as bacon, onion, or tomatoes. Are you familiar with this kind of jam?
    - Yes
    - No
    - Not sure
6. Have you ever made jam at home?
    - Yes
    - No

    [if No rerouted to Q23]
7. What type of jam have you made at home? (Select all that apply)
    - Berry
    - Apple
    - Bacon
    - Chili Pepper
    - Onion

- Marmalade
- Other: (response)

8. Do you wash your produce before making jam?
    - Always
    - Very often
    - Sometimes
    - Rarely
    - Never
9. Do you follow a recipe when making jam?
    - Always
    - Very Often
    - Sometimes
    - Rarely
    - Never

[If never rerouted to Q11]

10. Do you make ingredient substitutions when using a jam recipe?
    - Always
    - Very often
    - Sometimes
    - Rarely
    - Never
11. When making jam, do you adjust ingredients such as sugar or salt to suit your preferences (taste or nutrition)?
    - Always
    - Very often
    - Sometimes
    - Rarely
    - Never
12. What method do you use to process your jars at home?
    - Inversion
    - Water bath
    - Pressure canner
    - Non-processed (freezer or refrigerator)
    - Not sure

[If water bath proceed to Q13, if non-processed or not sure proceed to Q18, if inversion or pressure canner rerouted to Q14]

13. Do you consider your altitude when choosing boiling time?
    - Always
    - Very often
    - Sometimes
    - Rarely
    - Never
14. Do you measure headspace in your jars when canning?
    - Always
    - Very often
    - Sometimes

- Rarely
- Never

15. How long do you keep your sealed home-canned jam?
    - 0-30 days
    - 1 month- 6 months
    - 6 months- 1 year
    - 1- 2 years
    - Over 2 years
    - Not sure
16. Have you ever had a jar that did not seal properly?
    - Yes
    - No
    - Not sure

    (If no or not sure is selected proceed to Q18)
17. What do you do with that jar?
    - Store in fridge
    - Store in freezer
    - Reseal
    - Store at room temperature
    - Throw out
18. Has one of your home-canned jams ever spoiled?
    - Yes
    - No
    - Not sure

    [if No or Not Sure go to Q20]
19. If so, what were the signs of spoilage that you observed? (Select all that apply)
    - Jar broke
    - Bad smell
    - Mold
    - Color change
    - Fizzing
    - Off flavor
    - Strange texture
    - Other: Specify
20. If you had questions about canning, where would you look for an answer?
    - Government site (National Center for Home Food Preservation)
    - Recipe following
    - Family/friends
    - Cooperative Extension
    - Manufacturer of jar (i.e. Ball)
    - Search engine
    - Social media (Facebook groups, Reddit, etc.)
    - No questions on canning
21. Where do you store your jars after filling?
    - Shelf-stable (cabinet)
    - Refrigerator

- Freezer

22. Do you label your jars with contents and date of processing?
    - Always
    - Very often
    - Sometimes
    - Rarely
    - Never
23. Where do you usually find your recipes? (Select all that apply)
    - Cookbooks
    - Family/Friends
    - YouTube
    - Food blog
    - Television
    - Government site (National Center for Home Food Preservation)
    - Pinterest
    - Social media
    - Magazines/newspaper
    - Search engine (Google, Bing, etc.)
    - Other: response

[if not YouTube, Food blog, Social media, Government site, Pinterest or Search engine proceed to Q25]

24. How do you decide what recipe to use when online searching? (Select all that apply)
    - Relevance (first recipe)
    - View count
    - Subscriber count
    - Rating
    - Comments
    - Photos
    - Complexity
    - Ingredients
    - Likes
    - Recognition/familiarity of source
    - Other: (Specify)
25. Do you wash your hands before and after handling raw food?
    - Always
    - Very often
    - Sometimes
    - Rarely
    - Never

APPENDIX F: INFORMED CONSENT

You are invited to participate in an online survey for a research project. The goal of this project is to learn where home canners food safety habits and where home-consumers find/choose recipes. The project will be done by graduate student Alison Brodt and faculty sponsor Dr. Jennifer Perry from the School of Food and Agriculture. You must be at least 18 years old to participate.

What will you be asked to do?

If you decide to take part in this survey, you will be asked questions about yourself, where you choose recipes for home-canning, and your food safety habits while preparing homemade jam. All responses are anonymous and will take approximately 15 minutes to complete.

Risks

Your time and inconvenience are the only risk for participation in this study.

Benefits

Although there are no direct benefits to you, this research will help examine the food safety messages demonstrated to home-canners.

Confidentiality

This study is anonymous. All data will be kept on a password-protected computer indefinitely. After publication, the data will be kept in Digital Commons indefinitely so that other researchers may access the data as well as the public.

Voluntary

Taking part in this survey is voluntary. If you choose to participate in this study, you may stop at any time. You may not skip any questions. Submission of the survey implies consent to participate.

Contact Information

If you have any questions about this study, please contact:

- Alison Brodt, alison.brodt@maine.edu
- Dr. Jennifer Perry (faculty sponsor), jennifer.perry@maine.edu

If you have any questions about your rights as a participant in research, please contact the Office of Research Compliance, University of Maine, 207-581-2657 (or umric@maine.edu)

BIOGRAPHY OF THE AUTHOR

Alison Brodt was born in Hinsdale, Illinois, on September 25, 1996. She grew up in Elmhurst, Illinois, and Oak Brook, Illinois, where she graduated from York Community High School in 2015. After high school, Alison studied food science and human nutrition at the University of Maine. Alison graduated from the University of Maine in May 2019 with a Bachelor of Science in Food Science and Human Nutrition. After the conclusion of her master's, Alison has made plans to move back home to Oak Brook and begin a career in food science combining innovation and food safety. Alison is a candidate for the Master of Science Degree in Food Science and Human Nutrition from the University of Maine in August 2020.