

SURVEY OF HOME CANNING AND FREEZING
PRACTICES AMONG OKLAHOMA HOME AND
COMMUNITY EDUCATION ORGANIZATION
MEMBERS

By

JESSICA MORATH

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Texas A&M University

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Thesis Approved:

Dr. Barbara Brown

Thesis Adviser

Dr. Janice Hermann

Dr. Deana Hildebrand

Dr. Sheryl A. Tucker

Dean of the Graduate College

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CHAPTER I

INTRODUCTION

A surge of interest in home food preservation has occurred in recent years (Andress, Nickols, Peek, Nickols-Richardson, 2011). Reasons for this are many including a movement to buy locally produced food and increased interest in gardening, farmer's markets and food quality. Concerns regarding the safety of food and unknown economic conditions have also led to an increased attention on home food preservation. Research-based canning and freezing recommendations have been published for an extended period of time; however, reports indicate that many home preservers still participate in unsafe preservation practices.

A research survey was developed to gain insight on home canning and freezing practices. Topics of concern included what forms of preservation were taking place, how it was done, and why it was done. Members of the Oklahoma Home and Community Education (OHCE) organization, who attended their annual statewide meeting, were chosen as potential participants for this research project.

Problem Statement

The status of home canning and freezing practices in Oklahoma is currently unknown. Without knowledge of who is canning and/or freezing food at home, and how much and

what methods are being used in the process, current services providing information on canning and freezing may not be accessible or accepted by those participating in home food preservation. Unsafe home canning and freezing practices increase the risk of foodborne illness for those consuming the food and potential loss of food through spoilage. Technology changes may have impacted the preferred methods for home food preservers to access information on current recommended practices.

Purpose

The objectives of this project were to determine the prevalence of home canning and freezing in Oklahoma, whether those surveyed used recommended processing procedures, and their preferred method(s) for accessing current research-based home food preservation information. Results obtained from the project could aid in development and distribution of educational materials to meet the needs of people in Oklahoma interested in home food preservation.

Null Hypotheses

Hypothesis 1: Survey participants do not preserve food through canning at home.

Hypothesis 2: Survey participants do not use safe and recommended canning methods.

Hypothesis 3: Survey participants who canned food at home did not experience sealing failures or other forms of spoilage.

Hypothesis 4: Survey participants who canned food at home were not able to identify signs of spoilage in canned food.

Hypothesis 5: Survey participants do not preserve food through freezing.

Hypothesis 6: Survey participants do not use recommended freezing methods or procedures to maximize quality, nutrition and storage time.

Hypothesis 7: Survey participants will not be interested in additional information on home food preservation.

Hypothesis 8: Survey participants will continue to prefer traditional methods, technologies and sources to obtain information on home canning and freezing recommendations.

Limitations of Study

1. The convenience sample of OHCE organization members may not be a representative sample of the residents of Oklahoma.
2. Participants were primarily white non-Hispanic females who were over the age of 60 and not employed. These imbalances in the demographic characteristics of the participants may produce biased results limiting their use to be generalized to the entire population.
3. The sample size may not be adequate to get a clear representation of the home canning and freezing activities taking place.
4. Adverse growing conditions (bitter winter, late freeze, drought, extreme heat) experienced during the spring and summer of 2011 across Oklahoma could have impacted participant responses.
5. Use of partially complete surveys in statistical analyses could introduce bias and an improper understanding of the results.
6. A few of the Chi-square analyses, though statistically significant, had small sample sizes within some of the cells. All analyses presented in this paper contain sufficient data to be

considered valid. However, the small sample size should be taken into account when interpreting the results.

Definition of Terms

1. Oklahoma Home and Community Education (OHCE): An organization through the Oklahoma Cooperative Extension Service which is devoted to developing leadership while encouraging and supporting the best interest of the family, home, and community through continuing education (Oklahoma Home and Community Education, Inc).
2. United States Department of Agriculture (USDA): An organization run by the federal government which oversees a number of programs and agencies concerning food, agriculture, natural resources, and related areas using the highest quality science, public policy and well-organized management (United States Department of Agriculture).
3. Centers for Disease Control and Prevention (CDC): An organization committed to providing an increased health and quality of life to all individuals through programs that aid in prevention and control of diseases, injuries, or disabilities (Centers for Disease Control and Prevention, October 2011).
4. National Center for Home Food Preservation (NCHFP): Established through the Cooperative State Research, Education, and Extension Service, USDA, to attend to issues concerning food safety for those who teach and practice home food preservation. The Center provides sources for up to date research-based recommendations on home food preservation methods (National Center for Home Food Preservation, About us).
5. Oklahoma Cooperative Extension Service (OCES): Run through Oklahoma State University, OCES focuses on creating research-based programs that work to improve concerns of the local environment while developing leadership and the ability to properly manage resources through programs that focus on agriculture, the environment, health,

nutrition, family and community development and additional related topics (Oklahoma State University, Division of Natural Sciences and Natural Resources).

6. Case: Occurrence of one individual with foodborne illness (Centers for Disease Control and Prevention, February 2011).
7. Outbreak: Occurrence of two or more individuals with the same foodborne illness after a group of individuals consumes the same contaminated food product. (Centers for Disease Control and Prevention, January 2005)

CHAPTER II

LITERATURE REVIEW

Origins of Food Preservation

Food preservation has been vital to human existence throughout history. It allowed cultures to settle in one place and form communities by supplying food in times of scarcity (Nummer, 2002). Different climates promoted varying forms of early preservation methods such as dehydration in tropical areas and freezing meat within the ice in colder parts of the world. Other techniques used by early man and still in use today include pickling and fermentation. During the late 1700's and early 1800's French confectioner, Nicolas Appert, discovered that application of heat to food sealed in glass bottles increased the shelf life of the product. In 1810, Peter Durand of Great Brittan gathered the information on heat and extended shelf life that Appert had developed and applied it using a tin can instead of glass bottles. Following Durand's use of the tin can, Raymond Chevalier-Appert patented the pressure retort in 1851 which allowed for heating foods above 212° F. At this time of innovations in the art of canning it was known that the shelf life of canned items increased. However, the reason behind this was unknown until Louis Pasteur's finding of the connection between food spoilage and microorganisms in 1864. Since that time considerable advances have been made in the realm of food preservation to ensure a greater quantity and quality of the food supply.

History of Home Food Preservation in the U.S.

Throughout the last century participation in food preservation among homemakers has fluctuated. Times of war, economic hardship, advances in research and recommendations contributed to the varying messages sent to consumers regarding home food preservation (Nickols, Andress, Peek, Nickols-Richardson, 2010). Periods of food scarcity as well as a decreased quality and safety of food motivated people to consider preserving their own food products. The first half of 20th century brought with it two World Wars and the Great Depression which increased concerns of food security and promoted food conservation strategies. According to a report from the United States Department of Agriculture (USDA), seven out of ten households were preserving fruits and vegetables in 1944 (Bureau of Agricultural Economics, 1945).

During the latter half of the 20th century the prevalence of kitchen appliances, specifically freezers and microwaves, increased in the common household (Nickols, 2010). As these items became standard within households, greater attention was placed on the development of convenience foods for home consumption. Continued advances in technology coincided with a gradually changing role for women in the household. More women were entering the workforce leading to fewer women claiming the title of “stay at home mom” (Andress et al., 2011). A review of labor force statistics from 1950 to 1998 revealed a 25% increase in the number of women aged 16 and older in the workforce (Fullerton, 1999). One might speculate that these technological advances and increased occurrence of women in the workforce could have contributed to a decrease in activity of home food preservation. However, the century ended with a surge of interest in farmer’s markets, home gardening, and health and fitness which correlated with a sustained participation in home food preservation (Andress et al., 2011). Additional contributions to the maintenance of home food preservation in the United States (U.S.) developed out of fears of “Y2K”. This event occurred with the coming of the year 2000 as people hypothesized computers and other forms of machines, including health and information systems,

would crash with the turn of the century. The media began informing consumers of possible water and food deficiencies. As a result, greater emphasis was placed on food security and preservation during the last years of the 20th century.

Development of Current Canning and Freezing Recommendations

Early recommendations and instructions on how to preserve food came from many different sources including newspaper bureaus, magazines, agricultural extension services and companies that supplied products for home canning (Tanner, 1935). In 1909 the USDA published its first, of many, set of instructions on home canning (Breazeale, 1909). Unfortunately many of the recommendations being distributed were not based on sound research. Though research was being conducted, many findings concerning safe methods were yet to be discovered and those that had been were not being utilized in many of the recommendations.

Current instructions on how to safely preserve food at home are based on decades of research. Studies on heat penetration, utilized in safe canning methods recommended today, were developed in the 1920's (Nickols et al., 2010). These ground breaking studies included discovery of many microorganisms and spore formers, such as *Clostridium botulinum*, whose spores can resist heat up to 240°F. This temperature is considerably higher than most other non-spore forming bacteria, which are destroyed during normal cooking procedures. Microorganisms vary greatly in their requirements for growth, and knowledge of how to properly destroy them with heat is vital to preservation of safe food. Home canning research went full speed ahead between 1944 and 1946. Most of today's recommendations for the canning of meat, poultry and vegetables stemmed from studies conducted within those years. Research on frozen foods emerged during that time with the development of new technologies such as the home freezer. After a review of new research and past literature on home canning recommendations, the USDA released its first publication of the *Complete Guide to Home Canning* in 1988 (USDA, 1988). The review resulted in some old recommendations being tossed out while others were modified. The compiled list of

recommendations on different food products made it easier for the home canner to have access to proper canning instructions. The guide was revised in 1994 and again in 2009 (USDA, 2009). Those revisions updated canning procedures and added new processes for additional food products.

Home Canning and Freezing in the U.S. Today

In 1999 the USDA National Center for Home Food Preservation (NCHFP), located at the University of Georgia, was formed with goals to update current home canning and freezing recommendations as well as research canning methods on newly circulating products (Andress et al., 2011). Their objectives were expanded to include applied research through development of an undergraduate course in home food preservation, a web site, and online education materials. Utilization of the internet by the NCHFP to distribute researched based materials on home food preservation allowed interested individuals easier access to this information. Not only did it make materials more readily accessible but it gave consumers a reliable source to current preservation information.

Use of the internet in America today is widespread. In 2004 a telephone survey was conducted as a part of the Pew Internet and American Life Project (n = 2204) to determine factors surrounding usage of the internet among adults (Fox, 2004). They reported that 62% of adults ages 50-58 had access to the internet. This number decreased with age to 22% of adults aged 65 and older using the internet. In general, there was an increased usage of the internet among adults who were younger, had a higher level of education and a greater household income (Fox, 2004; Carpenter, Buday, 2007; Keenan, 2009; Hogeboom, McDermot, Perrin, Osman, 2010). The primary location of internet use was in the home however adults under the age of 65 were significantly more likely to use the internet at work compared to those over the age of 65 (Keenan, 2009). Though older adults were among those who use the internet the least, they were the fastest growing population of internet users (Fox, 2004).

The NCHFP conducted two national telephone surveys one in 2000-2001 and again in 2005 to gain information on the prevalence of home food preservation among the American population (Andress, D'Sa, Harrison, Kerr, Harrison, Nummer, 2002a; Andress, D'Sa, Harrison, Kerr, Harrison, Nummer, 2002b; D'Sa, Andress, Harrison, Harrison, 2007). Results indicated that roughly 22% of individuals who completed the full survey in 2005 canned food in 2004 (D'Sa et al., 2007). This number is slightly down from that seen in the previous survey (27%). Though 22%-27% of individuals canning food at home may not have seemed like many to some, the mass media and canning supply companies took note of the increased interest in home food preservation through news articles and designation of a National-Can-it-Forward-Day to promote participation in home canning (Jarden Home Brands, 2011). Jarden Home Brands, maker of Ball and Kerr canning supplies, and Canning Across America (CAA), a group of cooks, food lovers, and gardeners committed to the advancement of safe home food preservation and community building, worked to together to declare August 13th National Can-It -Forward Day (Jarden Home Brands, 2011; CAA, 2011). August 13, 2011, was the first annual National-Can-It-Forward-Day. Promotional activities included instructional videos on how to can food, cooking demos, and information on how to host a home canning party. The apparent increased interest was supported by a 28% rise in sales of all canning products at Jarden, as stated by Lauren Devine the Fresh Preserving community manager at Jarden Home Brands, in an interview with the Food Channel (Bailey, 2010). Quart-size jars had a 40% increase in sales. When asked about reasons why people were participating in home canning, Devine noted food safety and taste as primary contributors. With the rise in interest and participation, use of proper canning methods becomes a primary concern. When asked about tips for first time canners, Devine stressed the importance of using a tested recipe. She advised use of the USDA and Ball Blue Book of Preserving for reliable, tested recipe sources.

Though strongly recommended, use of research based recipes and instructions were not practiced by a large portion of home preservers. Respondents of the NCHFP surveys reported a

range of sources for their canning instructions (Andress et al., 2002b; D'Sa et al., 2007). The primary source was from family or friends (51% in 2005 and 49% in 2001). Additional sources included generic cookbooks and canning supplies manufacturers. Among those who reported canning in the 2005 survey, 31% made changes to the given instructions. Specific conditions must be present to inhibit growth of microorganisms and changing the recipe in any way can alter these conditions to allow for bacterial growth. Additionally, a high percentage of canners reported using the unsafe method of open kettle processing to can their fruits and tomatoes (44%) and vegetables (35%). The alteration of canning instructions and use of methods which were insufficient to properly process foods, place individuals participating in those practices at an increased risk for foodborne illness and spoilage leading to food loss.

Information concerning the storage, spoilage and consumption of home canned products was also collected during the national telephone survey in 2005 (D'Sa et al., 2007). The majority of respondents consumed food within 12 months but 36% reported storing food for greater than one year. At time of consumption, 11.5% of individuals who participated in home canning ate their food without prior heating and 24% only heated food until warm. Thirty percent of respondents brought food to a boil while 21% boiled the food product for 10 minutes before serving. Most home canners were able to identify common signs of spoilage including a bulging lid, mold, off-odor, off-color, leakage or spurting liquid when container is opened. However, only 45% of individuals believed that spoilage could occur in home canned foods without obvious signs of such.

Problems and Risks Associated with Home Canning and Freezing

Food spoilage can occur through contamination by a variety of microorganisms. Pathogens can enter into food products at different stages during canning and freezing. If home canned foods are not processed correctly foodborne illness can occur when the food is consumed. Even if illness is not a consequence, any resulting spoilage would result in loss of food and lost

resources. Spoiled foods are often discovered through off color or odor, the existence of gas in the container, and/or leakage (D'Sa et al., 2007). However, it is possible for canned food to spoil without any visual or other sensory signs of such. Intake of spoiled or pathogen containing foods could lead to illness or in the worst case, death.

Molds and yeasts are two types of microorganisms that can grow and cause food to spoil if the product is not properly preserved (Andress, Harrison, Reynolds, Williams, 2006). Molds can withstand low and high acid environments as well as drier ones in comparison to bacteria and the majority of yeasts. This microorganism appears as a fuzzy growth on food surfaces visible by the naked eye. Yeasts contribute to food spoilage through the process of fermentation. Like mold, yeasts can also grow in low or high acid environments. Certain preservation processes utilize the ability of yeast to ferment food, as in when making pickles or sauerkraut. However, fermentation is not always desirable and can produce an off taste in foods.

Flat-sour is an additional form of spoilage that occurs in canned foods (Landry, Schwab, Lancette, 2001). It is caused by spore forming bacteria most often as a result of under processing in low acid foods. Flat-sour spoilage leads to a decrease in pH, souring and occasionally off odor of the product. The organisms produce little to no gas so the product container remains flat in appearance as it should. *Clostridium nigrificans*, commonly referred to as a "sulfide stinker", is another spore forming bacteria that can cause spoilage in home preserved low acid foods. This spoilage is noted by the rotten egg odor and darkened appearance of the canned food item. The off smell and color occur as a result of hydrogen sulfide production and its subsequent reaction with components of the food product.

Spoilage of foods through contamination of molds, yeasts, flat-sours, and sulfide stinkers can cause minor sickness and loss of resources and therefore is of importance when discussing the safety of home preserved foods. However, foodborne botulism poisoning caused from the neurotoxin of spore forming *Clostridium botulinum* is the primary concern when discussing food safety in home canned food items (Sobel, Tucker, Sulka, McLaughlin, Maslanka, 2004).

Improperly processed home canned foods account for the majority of foodborne botulism outbreaks in the United States each year (U.S. Food and Drug Administration, 2009). The Centers for Disease Control and Prevention (CDC) (1998) has record of 289 foodborne botulism outbreaks, accounting for 65.1% of the total outbreaks, which were traced back to a home preserved food product between 1950 and 1996. In 2009, 11 cases and 3 outbreaks, accounting for 8 of the 11 cases, of foodborne botulism were reported (CDC, 2009). All of these occurred after consumption of a contaminated home canned food item based on epidemiologic evidence (CDC, 2009). One of the 11 cases resulted in death. In 2008, 8 of the 18 cases of foodborne botulism were traced back to contaminated home canned food products and again one death was reported (CDC, 2008). Death occurs following respiratory failure as a result of muscle paralysis caused by the toxin released from spores (U.S. Food and Drug Administration, 2009). Throughout the last 50 years the case-fatality ratio has decreased tremendously from 60% (1899-1949) to 15.5% (1950-1996) (CDC, 1998). Contributing factors to the reduction include improved respiratory intensive care units and an earlier administration of the antitoxin.

Clostridium botulinum is commonly found throughout nature but requires certain environmental conditions to grow and proliferate (Sobel et al., 2004). These include an anaerobic atmosphere, limited salt and a low amount of acid. Factors that will inhibit growth of the bacteria include refrigeration at temperatures below 39° F, application of heat greater than 240°F, increased water activity, or acidity at a pH less than 4.5. Toxins produced from spores are destroyed by heating the food product to 185° F for a minimum of 5 minutes. However it is best to prevent initial spore formation from the bacteria. In order to achieve this, low acid food products (pH greater than 4.5) must be heated to 240°F under 15-20 lb/in² of pressure for a minimum of 20 minutes and possibly longer depending on the food being canned.

Symptom onset resulting from botulism poisoning most often occurs within 18 to 36 hours after consumption of the toxic food product (U.S. Food and Drug Administration, 2009). Early signs and symptoms of foodborne botulism include exhaustion, weakness and vertigo

followed by double vision and a continued difficulty to speak or swallow. Other symptoms that may be experienced are weakness of multiple muscles, abdominal distention, and constipation. If treatment is not received within a short period of time the neurotoxin causes flaccid paralysis through blockage of motor nerve terminals. Paralysis moves downward in the body and once chest muscles are completely involved respiration is inhibited and death results due to lack of oxygen.

In Oklahoma, the last case of foodborne botulism intoxication reported occurred in 2005 (Oklahoma State Department of Health). A 14 year old female was admitted to the hospital following symptoms of nausea, vomiting, and difficulty speaking. Symptoms continued in severity to include irregular deep tendon reflexes, constipation, and paralysis in a descending fashion. Due to the set of symptoms and knowledge that the child recently consumed a home canned venison stew, foodborne botulism was detected as the probable cause of illness. Antitoxin was delivered by air from the CDC and given to the patient. *Clostridium botulinum* toxin type A was found by CDC's National Botulism Surveillance and Reference Laboratory in a serum sample obtained from the child. Following more than two months of mechanical ventilation, the patient was released but continued with rehabilitation for multiple months as a result of the paralysis. Knowledge of the severity of symptoms caused by foodborne botulism only heightens the need for use of safe preservation methods.

Additional Causes of Food Spoilage

When preserving food at home, whether by canning or freezing, a common goal is to not only put up a safe product but one with the highest quality possible. Contamination and spoilage of food by various microorganisms including molds, yeasts, and bacteria has been mentioned but there are additional factors which can contribute to food spoilage. Biological contamination by rodents and/or insects can occur if food is not properly preserved and stored (United Nations Conference on Trade and Development, 2007, p.12). Ongoing enzymatic reactions are another cause of spoilage that will lead to breakdown of the food product. Enzymes, which are naturally

present in foods, must be deactivated during the preservation method to prevent further breakdown. Chemical reactions contributing to oxidation and color changes in the food can diminish the quality of the preserved item and make it unpalatable. Finally, physical damage to foods prior to or after it has been processed may also lead to spoilage (United Nations Conference on Trade and Development, 2007, p.13). For example, if there is an open puncture in the fruit or vegetable, prior to preservation, it increases the risk of microorganisms entering in and contaminating the food product. Proper preservation techniques in canning and freezing diminish the risk of contamination and improve food quality.

Preservation Methods: Canning

Individuals can their own food at home for a number of reasons including nutritional benefits, decreased future food cost, decreased waste of home produced food and improved taste and quality of home canned items (USDA, 2009). Additional concerns over the safety of commercially produced foods and a wariness of the many additives in processed foods also motivated people to participate in canning their own food (Andress et al., 2011). Canning works to preserve food by decreasing the growth of microorganisms through heat processing, absence of oxygen, and destruction of food enzymes (USDA, 2009). Foods have differing levels of acid and moisture and thus must be prepared and processed using specified methods to ensure safety of the product. Low acid foods are those with a pH value greater than 4.6 whereas acid foods are classified as having a pH below 4.6. Low acid foods including vegetables, except when pickled, red meats, poultry and seafood must be processed in a pressure canner and/or undergo addition of an acid to decrease pH below 4.6. Acid foods including fruits, tomatoes and tomato products, pickles, sauerkraut, jams, jellies and marmalade can be canned through use of a boiling water bath. Among the acid foods, only fruits, tomatoes and tomato products can be processed using a pressure canner without a major loss of quality.

Pressure canning is utilized for low acid foods. Modern home pressure canners have thinner metal walls and are lighter compared to earlier equipment (USDA, 2009). Pressure is recommended for destruction of microorganisms in low acid foods not because of the pressure applied but because of the higher internal temperature reached that is a result of the increased pressure. Pressure between 10 to 15 pounds per square inch as measured by gauge (PSI) will create internal temperatures of 240° F to 250°F. This temperature is sufficient to kill harmful organisms such as *C. botulinum* spores. A pressure gauge determines the amount of pressure inside the canner. There are two types of gauges, dial and weighted. Dial gauges indicate the internal pressure through use of a needle pointer. Dial gauges require yearly checks for calibration to ensure their accuracy. A gauge that is not properly calibrated could produce unsafe food from under-processing. Weighted gauges maintain the pressure by a constant light rocking or jiggling of the gauge and do not require annual checks. This type of gauge contains “weights” used to adjust the amount of pressure applied. The weights are in 5 pound increments and thus are less flexible than dial gauges which can be adjusted in one pound increments. More flexibility is particularly important with small changes in altitude when only minor adjustments in pressure are needed. Altitude and proper exhaustion or venting of the canner prior to being pressurized are two factors that can affect the internal temperature of the pressure canner. It is vital to check altitude requirements and to properly exhaust the pressure canner to ensure the adequate internal temperature is reached. Processing times at the prescribed pressure vary depending on type of food, method of packing, and size of jars.

Boiling-water canning is safe for a variety of food products as long as they are not low acid in their final stage of preparation (USDA, 2009). The temperature in this type of canner can reach no higher than the boiling point of water, 212° F, at sea level. Boiling-water canners are most often large aluminum or porcelain-covered steel pots. However, most large pots will work as long as the water is a minimum of one inch above jars during processing with additional space allowed for the boiling activity of the water. A metal rack positioned in the bottom of the canner

is necessary to raise jars away from direct heat and allow water circulation underneath them. Additionally a fitted lid is needed to cover jars while processing. Canners are filled with water to a point so that once filled jars are placed inside there will be one to two inches of water above jars. The water is heated to 140°F prior to placing in raw packed filled jars or 180°F for hot packed jars and must come to a rolling boil after the jars are inserted. Once at a boil the prescribed processing time begins. It is important to keep sufficient water above the jars and to keep the water boiling to ensure safely canned food. Post processing and removal from the canner, jars should sit undisturbed for 12 to 24 hours to cool. Once a jar seal is confirmed the screw band should be removed and the jars gently washed. After this they can be stored in a cool, clean, dark and dry place at temperatures no greater than 95° F. Putting a label and date on the jar is recommended. For optimal quality and nutrition food should be consumed within one year. However, the food inside the jar will remain safe to eat unless the seal is broken. Each jar should be examined for signs of spoilage before the jar is opened and the food is eaten.

It is worth noting canning methods that are not recommended but which are used by home canners. Such methods include open kettle canning, steam canning, use of conventional ovens, microwave ovens, dishwashers, canning powders, and small amounts of acid. (USDA, 2009). These methods are not sufficient to eliminate the risk of contamination and spoilage. Open kettle canning is the practice of cooking the food product for a period of time and then placing the food in jars and sealing it (Andress et al., 2006). Since there is no additional processing, microorganisms may not be killed. Steam canning has not been adequately researched and therefore is not currently recommended. The steam does not heat jars in the same manner as a boiling water bath and so the same processing times cannot be used. Use of canning powders or the addition of small amounts of acid to low acid foods does not acidify the products enough to make them safe to can in a boiling-water canner. Dishwashers can be used to clean jars and hold them in a hot environment until they are filled, but the heat generated in a dishwasher is not sufficient to safely process canned food.

Preservation Methods: Freezing

Freezing is a simple, comparatively quick, and convenient method for preserving food. Freezing food does not kill present pathogens but does inhibit their growth as a result of the extremely low temperatures (Andress, et al., 2006). Also slowed in the cold environment are chemical reactions, such as those caused by enzymes, which contribute to changes and a loss of food quality leading to spoilage. Enzymes are proteins which are naturally present in fruits and vegetables. They must be inactivated to deter continued ripening and spoilage of the produce. In fruits, activated enzymes can cause browning and a loss of vitamin C. The best method to stop this process is to treat fruits prepared for freezing with a chemical compound, most often ascorbic acid (vitamin C) or some commercial mixture of it and additional compounds. To yield the highest quality of most vegetables when freezing, the enzymes present must be inactivated through a process called blanching. Blanching is a method by which the vegetables are exposed to boiling water or steam for a short period of time then subsequently emerged in cold water to halt the cooking process.

There are different methods of blanching though use of boiling water is preferred for all vegetables (Andress et al., 2006). To water blanch, obtain a blancher or large pot, a metal basket that can be placed inside the pot, and a lid. One gallon of water to one pound of vegetables is recommended. Prepared vegetables are placed into the basket then in the boiling water. Once water returns to a boil the timing begins. It is important to thoroughly read instructions and accurate cooking times for individual vegetables because they will vary depending on the specific vegetable and its size. Processing times must be followed exactly to yield the highest quality product. Corn-on-the-cob, for example, has three different blanching times depending on the size of the ear, and when freezing whole kernel or cream style corn the ears must be blanched prior to removing the kernels from the cob. Steam blanching is only recommended for a select few vegetables including broccoli, pumpkin, sweet potatoes, and winter squash though cooking times do exist for other vegetables. Steam blanching is a process by which a couple inches of water are

brought to a boil in a large pot then a basket with a single layer of vegetables is lowered into the pot so that it is at least three inches above the bottom. A lid is placed on the pot and the processing time begins at this point. Blanching vegetables with steam takes roughly 1 ½ times longer than water blanching. The final method occasionally used to prepare vegetables for the freezer is microwave blanching. It is not currently recommended for any vegetables due to uneven heating patterns and the impact of quantity of food on heating time. Some research has shown that it may not inactivate all enzymes and could contribute to a change in flavor, poor texture, and loss of color in the vegetable. Those who participate in this method should blanch in small quantities and follow instructions based on their individual microwave model yet use of the microwave to blanch vegetables does not pose any benefits. No matter the method used, blanched vegetables must be fully submerged into cold water (60° F or below) immediately following removal from water or steam. This process stops the continued cooking of the vegetable and should take around the same amount of time as recommended for blanching. Once cooled, vegetables should be thoroughly drained as extra moisture when freezing can decrease the quality of the product.

As stated, recommended blanching times must be followed exactly (Andress et al., 2006). Overblanching can result in a mushy product that has a decreased flavor, color, and nutrients. On the other hand, underblanching stimulates enzyme activity and results in a worse product than no blanching at all.

Rancidity is another chemical change that can occur during freezing and results are not reversible. This happens when foods containing fat, such as meat, are exposed to air. Hence, removing as much air as possible is beneficial.

Changes in texture resulting in a poor quality of the food will occur if large ice crystals are allowed to form, subsequently causing cell walls to rupture. Large ice crystals will form when there is excess water in the product or if food that is frozen at too slow a rate as a result of overloading the freezer with unfrozen product. Fluctuations in the freezer's temperature and

subsequent thawing then refreezing of the food can also cause large crystals to form from smaller ones. Additionally, moisture loss and evaporation of ice crystals causes the product to dry out and become tough in spots. This produces freezer burn and leaves food in an unusable state.

If extensive freezing will be undertaken it is important to have an appropriate freezer and maintain care of it (Andress, et al., 2006). Maintenance includes defrosting the freezer as needed and removal of odors left from spoiled food. It is a good rule of thumb to clean out freezers at least once a year to remove visible residues and any food products that have gone bad. Proper containers to package food must be used to give the highest quality product in terms of flavor, texture, color and moisture. Extensively labeling the product with the date, description of food item and any other relevant information prior to freezing is recommended. Use of specific freezing instructions for different food products is recommended to ensure the highest quality product.

Cost of Canning, Freezing and, Storing Food at Home

Preserving food at home has many benefits. Food is readily available for consumption and one has knowledge of where the food is from and what ingredients were involved. With the continued rises in food cost, some individuals have additionally stated cost savings as a perceived benefit to canning and freezing food at home (Andress et al., 2011). However, the perceived cost savings may be overestimated. Factors such as money spent on produce production and/or purchase, costs for added ingredients, equipment and supplies, fuel cost, and the values of personal time and labor all influence the value of home preserved food (Kendall, Payton, 2008). Due to the variability that surrounds these factors, determining cost of food preservation can be difficult. Cost of produce is considered whether an individual is canning or freezing. Produce may come from a home garden, the farmer's market, family, friends, or another source; each has its own factors to consider.

Canning methods can vary from one household to the next and as a result the actual costs involved will also vary (Kendall et al., 2008). Costs to consider are purchase of canners, special equipment, jars and lids, water and fuel, and added ingredients such as sugar and vinegar. The start-up cost for a canner and jars may be high, but the lifespan of a canner is 20-40 years and jars may be used 10 times or more. Storage space at the correct temperature must be available for jars of food. If it is too hot or cold the food may spoil causing a loss of product and increase in cost per yield of canned food item and increase the risk of foodborne illness. Yet after all cost contributors are taken into account, research has demonstrated that home canning is often more economical than freezing food due to the costs of maintaining frozen storage.

Freezing food has advantages that it is quick, simple, and keeps produce closer to its original “fresh” state than any other preservation method. However, it is expensive to buy and operate a freezer even though it has a lifespan of roughly 20 years (Kendall et al., 2008). Additional costs are freezer maintenance and repair, electricity to reach and hold a constant temperature of 0° F, packaging for food, water and fuel to prepare food for freezing and any added ingredients. The operating cost to store 525 pounds of food for a year in a 15-cubic foot freezer was estimated to be 40.2 cents per pound of food. Over half of this cost, 24.08 cents per pound, was contributed to electrical energy at 2.4 kilowatt hour (kWh) per pound at 10 cents per kWh. This is the energy required to maintain a freezer at 0°F. Cost of produce and other ingredients should be added to this price. If a freezer is already available and food is economically obtained, then freezing food at home can be an inexpensive way to preserve it. Cost can further be reduced in terms of the electrical energy used by a freezer if a few simple rules of thumb are followed. Freezers use more energy if placed in a warmer room, undergo frequent door openings, have a minimal amount of food in them, and have poor insulation. The type of freezer, chest or upright, manual defrost or frost-free; also determine the amount of energy used to maintain the proper temperature. When deciding what method of food preservation to use, determining current available resources and those that would be needed can aid in choosing an

appropriate method for a given household. Frozen food should be used within the recommended storage time. Beyond that time limit quality of food deteriorates and cost of the food increases as electricity must be continually purchased to maintain storage.

Comparison of the Nutritional Value of Fresh, Frozen, and Canned Foods

It is well known that fruits and vegetables are most nutritious and flavorful when picked at the peak of ripeness. On average fruits and vegetables are over 90% water and once harvested they undergo respiration at a high speed (Rickman, Barrett, Bruhn, 2007a). Subsequently, fruits and vegetables begin to lose moisture, deteriorate, and have increased risk of microbial spoilage. Refrigeration of fresh products is one way to decrease the rate of respiration. As has been discussed, canning and freezing serve as additional methods to preserve foods for consumption at a later date. In most areas across the country, including Oklahoma, the growing season is not year round and even during the season not all fruits and vegetables can be grown due to varying climates. Hence it is not always convenient or even possible to have fresh produce. Fresh fruits and vegetables can be thought by consumers to have the highest nutritional value since they are not processed. However, research has shown that this may not be the case in all situations. In a review of literature, Rickman and colleagues compared the nutritional value of fresh, frozen, and canned fruits and vegetables. They looked at differing storage times and atmospheres as well as the impact of cooking on nutrients. The review, divided into two parts, focused on water soluble vitamins C and B and phenolic compounds in part 1, then vitamin A and carotenoids, vitamin E, minerals, and fiber in part 2 (Rickman et al., 2007a; Rickman, Bruhn, Barrett, 2007b). Determining the nutritional value is highly complex and variable considering it is dependent on the specific cultivar, place of production, stage at harvest, season, and processing methods.

The initial exposure to high heat in the canning process results in a loss of nutrients, namely those that are water soluble and heat sensitive, yet with further storage there is not a substantial loss of nutrients (Rickman et al., 2007a). Freezing produce decreases the initial loss of

nutrients due to the short blanching time yet more are diminished during storage as a result of oxidation. Fresh fruits and vegetables are most often higher in nutrients when harvested yet with storage they undergo a high rate of deterioration compared to the canned or frozen counterpart. Therefore, fresh fruits and vegetables are best eaten in a short amount of time to receive the highest amount of nutritional benefits. If a large quantity of produce is available that cannot be consumed quickly, properly preserving it through canning or freezing following acquisition may deter further nutrient loss and yield a higher quality product. Rickman and colleagues (2007b) indicated that some nutrients including vitamin A and carotenoids, vitamin E, minerals, and fiber have minimal differences in similar fresh and processed products. However, the differing methodology and report of results did complicate the extrapolation of data. Minerals and fiber most notably remain stable throughout processing and storage if not peeled. Under consideration of the many factors that affect nutrient content, a wide variety of products including fresh, frozen, and canned are recommended to meet the daily requirements of fruits and vegetables.

Oklahoma Cooperative Extension Service

The prevalence of home canning and freezing in Oklahoma is unknown. However, residents of Oklahoma who do or want to preserve food at home have access to a variety of home canning and freezing resources through the Oklahoma Cooperative Extension Service (OCES). Some of the services provided include in-service training of County Educators in Family and Consumer Science and 4H on best practices for home canning and freezing. Fact sheets and new materials are prepared to stay up to date with current research. Canning and freezing workshops are hosted throughout the state to educate the public on proper home preservation procedures. The Oklahoma Gardening program on OETA (the public television network) is also utilized to give tips and recommendations on preserving food at home. Most of these services are traditional methods of educating and distributing home food preservation guidelines. With the increasing

advances in technology, additional methods to distribute accurate information may be necessary to best meet the needs of Oklahoma residents.

CHAPTER III

METHODS

Description of Participants

This study utilized a convenience sample of participants who attended the 2011 OHCE state meeting in July in Oklahoma City. All individuals who attended the conference had an equal opportunity to participate in the study.

Description of Data Collection

Participants were recruited during registration and throughout the three day conference. A table was set up near the registration center that included the participant information sheet (Appendix C), survey handout (Appendix D), poster (Appendix E), and research survey (Appendix F). All documents and handouts given to participants were approved by the Oklahoma State University Institutional Review Board. A copy of the approved and signed form is provided in Appendix A. Potential participants were greeted as they passed the table and information concerning the project (the recruitment script, Appendix B) was presented to them. Each person was asked to read the participant information sheet and make a decision to participate, and then complete the research survey. No OHCE member was denied the opportunity to take the survey.

Participants were allowed to take the survey with them while at the conference to give ample time for completion, but were requested to return their completed survey prior to leaving the conference. Individuals were instructed to return completed surveys to a designated location. Reminders to complete and return the survey were given at various times throughout the course of the three day conference. A location was provided to return completed surveys until the end of the conference. All participants who picked up a research survey received a handout (Appendix D) which provided information on the recommended method for freezing corn-on-the-cob, whole kernel corn, and cream style corn. This complimentary handout was developed by Jessica Morath and is based on USDA recommended methods for freezing fresh corn.

Description of Research Survey

The instrument was developed by Jessica Morath and Barbara Brown. A portion of the questions were based on a national telephone survey conducted by the NCHFP in 2005 (D'Sa et al., 2007). This national survey sought to determine consumer home food preservation practices and knowledge among Americans. Utilization of the NCHFP survey provided standardized, research tested questions.

The research survey was divided into three sections. The first asked questions regarding home canning practices in the last 12 months, July 2010 to July 2011. Topics included what foods were canned, how much was canned and canning methods used. The second section contained questions concerning freezing practices in the previous 12 months including which foods were frozen, amounts frozen and methods used. The final section asked demographic questions including age, gender, employment status outside the home, education level, household size, race/ethnicity and income. Questions in this section sought to determine participants' interest in

receiving additional information on home food preservation and how they would prefer to obtain that information.

Statistical Analysis

The nature of this study did not seek to identify cause and effect. Therefore, descriptive statistics were utilized to seek patterns in the data. Responses to each survey question were coded and entered into a Microsoft Excel worksheet. Relative frequency tables were formulated for each survey question using the coded data. Chi-square, test of independence, statistics were utilized to determine if significant relationships existed among variables within the survey data compared to that which is expected in the larger population.

Differences in response frequency distributions (participants reporting they canned food in the previous 12 months, participants reporting they froze food in the previous 12 months, reasons reported for canning food at home, and sources reported for home canning instructions) by (age, education, employment status, and income) were conducted using Chi-square analysis. Differences in response frequency distributions (reasons reported for canning or freezing food at home, and reported sources of food for canning or freezing at home) by income were also conducted using Chi-square analysis.

Responses to the demographic questions regarding age, employment status, level of education, and total household income were collapsed into two or more categories per question due to cell size for Chi-square analysis. There were two age categories (18 – 60 and greater than 60). There were two employment status categories (employed (part or full time) and not employed). There were three level of education categories (high school graduate or less, some college or a two year college degree, and four year college degree or post-graduate/professional

school). Finally, there were three income categories (less than \$39,000, \$40,000 - \$79,999, and greater than \$80,000).

Frequencies and Chi-square analyses were conducted using PC SAS for Windows, Version 9.1 (SAS Institute, Cary, NC). Significance level was set at $p < 0.05$.

CHAPTER IV

RESULTS

Of the 220 research surveys handed out to participants, 119 were returned (54%). Two surveys were removed due to inadequate completion leaving 117 used for analysis. Retention was based on an apparent attempt by the participant to complete the survey. Most participants fully completed the research survey. Criteria for inclusion in analysis were a minimum of 80% of the 50 survey questions complete.

The number who responded to individual questions varied because participants were instructed to skip sections where they had no experience within the previous 12 months. For example, if the participant had done no home canning at home in the past year, they were instructed to skip to the next section on freezing food at home.

Only Chi-square analyses in which significance was found were reported in the results.

Participant Demographics

Of those who responded to the corresponding question on the research survey, participants were primarily female (99%), over the age of 60 (62%), and not employed (59%) (Table 1). The majority had at least attended some level of higher education (81%) and classified their race as white non-Hispanic (87%). Nearly half of the respondents (47%) listed the middle

range (\$40,000 - \$79,999) for total household income while a third (31%) fell into the lower income range (less than \$39,000). Most participants had two people living in their household (56%). However, 29% had 3 or more individuals in their household and 21% had one or two people under the age of 18 living with them.

Table 1 Demographic characteristics of home canning and freezing survey participants

Demographic variable	n (%)
Gender (n=115)	
Female	114 (99%)
Prefer not to answer	1 (1%)
Age (n=115)	
18-60	44 (38%)
>60	71 (62%)
Employment Status (n=114)	
Employed, part or full time	47 (41%)
Not employed	67 (59%)
Level of education (n=114)	
High school graduate or less	21 (19%)
Some college or a 2 year college degree	39 (34%)
4 year college degree and/or post-graduate/professional school	54 (47%)
Race (n=106)	
White non-Hispanic	92 (87%)
Native American or Alaskan native	12 (11%)
Other	2 (2%)
Household income in 2009 (n=87)	
<\$39,999	27 (31%)
\$40,000-\$79,999	41 (47%)
>\$80,000	19 (22%)
Number of people living in household (n=114)	
1 person	17 (15%)
2 people	64 (56%)
3 people	16 (14%)
4 or more people	17 (15%)
Number of people under age 18 living in household (n=113)	
0 people	89 (79%)
1 person	16 (14%)
2 people	8 (7%)

Reason for Participation and Sources of Food for Canning and Freezing Frequency Data

The main reasons listed for participation in home canning and/or freezing were quality (62%), cost savings (56%), nutrition (35%), and other (enjoyment, did not want to waste available produce, convenience) (31%) (Table 2).

Table 2 Reasons reported for canning and freezing food at home

What factors contributed to your participation in home food canning or freezing in the last 12 months? (Check all that apply) (n=115)	n (%)
Quality	71 (62%)
Cost savings	64 (56%)
Nutrition	40 (35%)
Other	36 (31%)
Food safety	23 (20%)

The home garden was the primary source for fruits and vegetables participants canned or froze (64%) (Table 3). In addition to the home garden, 44% received produce from the garden of a friend or relative, 40% from the farmer's market, and 39% from a grocery store.

Table 3 Source of fruits and vegetables used for canning or freezing at home

Where did you get the fruits and vegetables you canned or froze at home in the last 12 months? (Check all that apply) (n=111)	n (%)
Home garden	71 (64%)
Garden of friend or relative	49 (44%)
Farmer's market	44 (40%)
Grocery store	43 (39%)
Harvested from the wild	21 (19%)
Pick-your-own at a farm	8 (7%)
Other	2 (2%)

Reason for Participation and Sources of Food for Canning and Freezing Chi-square Analysis

Seventy-two percent of the respondents and/or their families grew, raised, hunted, or fished for their own food in the 12 months prior to survey completion. There was a significant difference in whether or not participants reported the family grew, raised, hunted, or fished for

their food by income (Table 4). Participants in the middle (\$40,000-\$79,999) or high (> \$80,000) income categories were more likely to report they grew, raised, hunted or fished for food. Additionally, there was a significant difference in cost savings being a factor that contributed to home canning or freezing by income (Table 5). Participants in the lower (<\$39,000) and middle (\$40,000 - \$79,999) income categories were more likely to report cost savings as a contributing factor.

Table 4 Frequency of participants growing, raising, hunting or fishing for food by income

Survey Question	Income						Chi-Square	
	<\$39,000		\$40,000-\$79,999		>\$80,000		x ²	p value
Did your family grow, raise, hunt or fish for any of your own food in the last 12 months?	n	(%)	n	(%)	n	(%)	10.26	0.006*
Yes	15	23	33	50	18	27		
No	12	57	8	38	1	5		

* p-value < 0.05 was considered significant

Table 5 Frequency of cost contributing to participation in home canning or freezing by income

Survey Question	Income						Chi-Square	
	<\$39,000		\$40,000-\$79,999		>\$80,000		x ²	p value
What factors contributed to your participation in home canning or freezing in the last 12 months?	n	(%)	n	(%)	n	(%)	8.42	0.015*
Cost savings	21	43	21	43	7	14		
Cost savings not a reason	6	16	20	53	12	31		

* p-value < 0.05 was considered significant

Canning Frequency Data

Overall, 77% of participants reported canning food at home from July 2010 to July 2012.

Those that did not participate in home canning were directed to skip to the next section of the

survey which posed questions on home freezing practices. The most common reason for canning food at home was preferred quality and/or flavor (75%) (Table 6). Additional reasons included other (gifts, county fair, enjoy it, use of garden produce) (37%), saving money (33%), health reasons (12%), and like to create recipes (18%).

Table 6 Reasons for participation in canning among individuals who canned food at home

Why did you or your family can food at home? (Check all that apply) (n=89)	n (%)
Prefer home canned quality and/or flavor	67 (75%)
Other	33 (37%)
Save money	29 (33%)
Like to create recipes	16 (18%)
Health reasons	11 (12%)

Eighty-three percent of home canners used the Ball Blue Book for canning or preserving instructions making it the primary source utilized (Table 7). State or university extension service publications (47%) family members or friends (30%), and USDA publications (27%) were other commonly used resources.

Table 7 Source of canning instructions used in preserving among home canners

Where did you get the home-canning instructions you used in canning or preserving in the last 12 months? (Check all that apply) (n=90)	n (%)
Ball Blue Book	75 (83%)
State or University Extension services	42 (47%)
Family members or friends	27 (30%)
USDA publications	24 (27%)
Directions from manufacturer of pressure cooker/canner	14 (16%)
Directions from manufacturers of jars/lids	13 (14%)
Other	12 (13%)
National Center for Home Food Preservation website	9 (10%)
General cookbook	6 (7%)
Magazines or newspapers	4 (4%)
Other internet sites	3 (3%)
Television	0 (0%)
Don't know	0 (0%)

Twenty-seven percent of participants modified some or all of their canning instructions.

Two survey questions asked about the type of food canned. Frequency results were similar for both questions. The most commonly canned food items were jams, jellies and/or preserves at 74% of home canners (Table 8). This was followed by 63% canning tomatoes or tomato products, 56% pickles, and 51% to 50% canning fruits and vegetables, respectively.

Table 8 Food items canned in the last 12 months

Which of the following did you can in the last 12 months? (Check all that apply) (n=90)	n (%)
Jams, jellies, or preserves	67 (74%)
Tomatoes or tomato products	57 (63%)
Pickles	50 (56%)
Fruit	46 (51%)
Vegetables	45 (50%)
Other	9 (10%)
Meat	1 (1%)

The majority, 83%, of individuals did not use artificial sweeteners in their home canned food products. Those that did primarily placed them in jams, jellies, or preserves (Table 9).

Table 9 Use of artificial sweeteners in food canned at home

Did you use artificial sweeteners in any of the following home canned foods? (Check all that apply) (n=89)	n (%)
No, did not use artificial sweeteners	74 (83%)
Jams, jellies, or preserves	11 (12%)
Fruits	5 (6%)
Pickles	4 (5%)
Salsas	2 (2%)
Other	2 (2%)
Don't know	0 (0%)

Nine percent of participants indicated they had not canned fruits or tomatoes in the previous 12 months. Of those who did 95% used a boiling-water bath, 21% a pressure canner, and 18% open kettle processing (Table 10). Twenty-two percent responded that they had not canned

vegetables in the previous 12 months when asked about methods used to can vegetables. Of those who had, 57% used a pressure canner, 49% a boiling-water bath, and 7% open kettle processed (Table 11).

Table 10 Methods used by participants who canned fruits and/or tomatoes within the previous 12 months

Which of the following methods did you use to can fruits and/or tomatoes in the last 12 months? (Check all that apply) (n=82)	n (%)
Boiling-water bath	78 (95%)
Pressure canner	17 (21%)
Open kettle	15 (18%)
Pressure saucepan or cooker	3 (4%)
Other	3 (4%)
Oven	1 (1%)
Steam Canner	0 (0%)

Table 11 Methods used by participants who canned vegetables within the previous 12 months

Which of the following methods did you use to can vegetables in the last 12 months? (Check all that apply) (n=69)	n (%)
Pressure canner	39 (57%)
Boiling-water bath	34 (49%)
Open kettle	5 (7%)
Pressure saucepan or cooker	3 (4%)
Other	2 (3%)
Oven	0 (0%)

Of the participants who pressure canned food with a dial gauge pressure canner, 17% of them had the dial gauge tested in the 12 months prior to the survey (Table 12). All those participants utilized the County Extension Service to test their dial gauge.

Table 12 Dial gauge testing on the pressure canner

Did you have the dial gauge on the pressure canner you used tested in the last 12 months? (n=88)	n (%)
No	45 (51%)
Did not use a pressure canner	18 (21%)
Yes	15 (17%)
My canner does not have a dial gauge	10 (11%)
Don't know	0 (0%)

Eighteen percent of individuals who canned vegetables made an adjustment for altitude when canning vegetables while 23% did not make an adjustment and were unaware if one was necessary (Table 13). Fifty-nine percent stated an adjustment was not needed where canning was done. Among individuals who canned fruits and/or tomatoes, 21% made an adjustment for altitude (Table 14). Twenty-nine percent did not make an adjustment and were unaware if one was necessary, and 46% stated an adjustment was not necessary where canning was done.

Table 13 Adjustment for altitude when canning vegetables at home

If you canned vegetables in the last 12 months, did you make adjustments for altitude? (n=66)	n (%)
Adjustment not necessary where canning was done	39 (59%)
No, did not make an adjustment and unaware if adjustment is necessary	15 (23%)
Yes, made adjustment	12 (18%)
Don't know	0 (0%)

Table 14 Adjustment for altitude when canning fruits and/or tomatoes at home

If you canned fruits and/or tomatoes in the last 12 months, did you adjust the boiling-water processing time for altitude? (n=78)	n (%)
Adjustment not necessary where canning was done	36 (46%)
No, did not make an adjustment and unaware if adjustment is necessary	23 (29%)
Yes, made adjustment	16 (21%)
Don't know	3 (4%)

Twenty-eight percent of participants who home canned tomatoes did not add an acid to each jar during processing (Table 15). Among those that did add an acid, 23% used commercially prepared lemon juice, 26% vinegar with 5-6% acidity, and 14% citric acid.

Table 15 Type of acid added to tomatoes canned at home

What type of acid did you add to each jar of home canned tomatoes in the last 12 months? (n=57)	n (%)
I did not add an acid	16 (28%)
Vinegar, 5-6% acidity	15 (26%)
Commercially prepared lemon juice	13 (23%)
Citric acid	8 (14%)
Fresh squeezed lemon juice	4 (7%)
Other	1 (2%)
Vitamin C	0 (0%)

All participants stated they used jars designed for home canning with two piece metal jar lids when canning food at home (Table 16). However, 7% of participants stated they also used recycled jars originally sold containing other foods such as peanut butter or salad dressing.

Table 16 Jars used for canning food at home

What kind of jars did you use for home canning? (Check all that apply) (n=89)	n (%)
Jars designed for home canning with the two piece metal jar lid	89 (100%)
Recycled jars originally sold containing other foods, such as peanut butter, coffee, salad dressing	6 (7%)
Jars currently sold for home canning with other types of lids	4 (4%)
Other	1 (1%)
Don't know	0 (0%)

Thirty-four percent of home canners had at least one jar that did not seal properly in the previous 12 months. The average number of unsealed jars was three with a maximum of seven (Table 17). Of those with unsealed jars, 67% put the jars in the refrigerator and ate the contents within three days (Table 18). Twenty percent reprocessed the jars within 24 hours of original canning and 20% threw them out.

Table 17 Frequency of jars that did not seal properly

How many jars would you say did not seal properly? (n=30)	n (%)
2	10 (33%)
3	6 (20%)
4	5 (17%)
5	3 (10%)
1	3 (10%)
6	2 (7%)
7	1 (3%)

Table 18 Treatment of jars that did not seal properly

What did you do with the jars that did not seal? (Check all that apply) (n=30)	n (%)
Put them in the refrigerator and ate the food within 3 days	20 (67%)
Reprocessed them within 24 hours of original canning	6 (20%)
Threw them out	6 (20%)
Froze the contents	1 (3%)
Don't know/other	0 (0%)

The participants were asked what method they used most often to prepare home canned vegetables such as green beans, carrots and corn. Of those who canned vegetables, 42% boiled them uncovered for 11 minutes or more and 25% at least brought them to a boil (Table 19).

Table 19 Method used to prepare and serve vegetables canned at home

Which of the following methods do you use most often to prepare and serve home canned vegetables, such as green beans, carrots, and corn? (n=59)	n (%)
Boil uncovered for 11 minutes or more	25 (42%)
Bring to a boil	15 (25%)
Use as an ingredient in other recipes	8 (14%)
Heat until warm (whether in oven, microwave or on stovetop)	5 (9%)
Other	3 (5%)
Steam	2 (4%)
Serve as is with no further heating	1 (1%)
Don't know	0 (0%)

Nine percent of participants had home canned food spoil in the previous 12 months. Most individuals were able to identify common signs of spoilage in a home or commercially canned food item including bulging lid, leakage, mold, off-color, off-odor, and spurting liquid when the container is opened (Table 20). Fifty-three percent of home canners also chose flavor as an indication of spoilage in a canned food item. Sixty percent of participants believed a home or commercially canned food could be spoiled without any signs of such while 19% believed there would always be some sign of spoilage and 21% did not know (Table 21).

Table 20 Reported signs of spoilage in home canned or commercially canned foods

Which of the following signs might mean that home canned or commercially canned foods may be spoiled? (Check all that apply) (n=89)	n (%)
Bulging lid	82 (92%)
Mold	78 (88%)
Leakage	77 (87%)
Off-odor	73 (82%)
Off-color	69 (78%)
Spurting liquid when container is opened	55 (62%)
Flavor	47 (53%)
Floating fruit or vegetable	20 (22%)
Don't know	0 (0%)

Table 21 Knowledge regarding the necessity of a sign for spoilage to occur

Could home canned or commercially canned foods be spoiled without any signs of spoilage, or would there always be some sign of spoilage? (n=88)	n (%)
Could be spoiled without any sign	53 (60%)
Don't know	18 (21%)
Would always be some sign of spoilage	17 (19%)

Among all the participants who answered the question, 68% stated they have or plan to can food in 2011, 19% do not know, and 13% do not plan to can (Table 22).

Table 22 Predicted participation in home canning for 2011

Have you or do you plan to can food at home in 2011? (n=112)	n (%)
Yes	76 (68%)
Don't know	21 (19%)
No	15 (13%)

Canning Chi-square Analysis

There was a significant difference in participants reporting they canned food in the last 12 months by income (Table 23). Participants in the low (<\$ 39,999) or middle (\$40,000 - \$79,999) income categories were more likely to report they canned.

Table 23 Frequency of participants reporting they canned in the last 12 months by income

Survey Question	Income						Chi-Square	
	<\$39,000		\$40,000-\$79,999		>\$80,000		x ²	p value
Did you can any foods in the last 12 months?	n	(%)	n	(%)	n	(%)	13.62	0.001*
Yes	24	35	35	52	9	13		
No	3	16	6	31	10	53		

* p-value < 0.05 was considered significant

A significant difference was also observed in cost being reported as a reason for canning at home by age category (Table 24). Individuals who reported they canned to save money were more frequently over 60 years of age.

Table 24 Frequency of saving money reported as a reason for canning by age category

Survey Question	Age				Chi-Square	
	18-60		>60		x ²	p value
Why did you or your family can food at home?	n	(%)	n	(%)	6.95	0.008*
Save money	5	19	22	81		
Saving money not a reason	29	48	31	52		

* p-value < 0.05 was considered significant

Additionally, there was a significant difference in participants reporting saving money as a reason for canning by income (Table 25). Participants who reported saving money as a factor for canning were more likely to be in the low (<\$39,000) or middle (\$40,000 - \$79,000) income category.

Table 25 Frequency of saving money reported as a reason for canning by income

Survey Question	Income						Chi-Square	
	<\$39,000		\$40,000-\$79,999		>\$80,000		x ²	p value
Why did you or your family can food at home?	n	(%)	n	(%)	n	(%)	7.94	0.019*
Save money	12	55	10	45	0	0		
Saving money not a reason	12	26	25	54	9	20		

* p-value < 0.05 was considered significant

Significant differences were observed in sources of information reported to be used by participants by age, employment, and income. There was a significant difference in the source of canning instructions by age (Table 26). Individuals who reported they used USDA publications as a source for instructions were more likely to be under 60 years of age. Participants who reported they used USDA publications as a source were also more likely to be employed (Table 27). A significant difference was additionally observed in the frequency of using USDA publications as a source for instructions by income (Table 28). Participants who reported they used USDA

publications were more likely to be in the middle (\$40,000 to \$79,000) to upper (>\$80,000) income categories. Individuals who reported they used instructions from the manufacturer of their pressure cooker/canner were more likely to be over the age of 60 (Table 29). Additionally, there was a significant difference in use of family members or friends as a source for canning instructions by employment status (Table 30). Participants not employed outside the home were more likely to report they received instructions from family and friends more often than those who were employed. A significant difference was also observed in the frequency of participants reporting they used family or friends' instructions for canning or preserving by education (Table 31). Participants who had a two year college degree or less were more likely to use family and friends as a source for canning instructions.

Table 26 Frequency of reported use of USDA publications by age category

Survey Question	Age				Chi-Square	
	18-60		>60		x ²	p value
Where did you get the home-canning instructions you used in canning or preserving in the last 12 months?	n	(%)	n	(%)	4.75	0.029*
USDA publications	14	58	10	42		
Not from USDA publications	21	33	43	67		

* p-value < 0.05 was considered significant

Table 27 Frequency of using USDA publications as a source of canning instructions by employment

Survey Question	Employment Status				Chi-Square	
	Employed		Unemployed		x ²	p value
Where did you get the home-canning instructions you used in canning or preserving in the last 12 months?	n	(%)	n	(%)	8.57	0.003*
USDA publications	17	71	7	29		
Not from USDA publications	23	36	41	64		

* p-value < 0.05 was considered significant

Table 28 Frequency of using USDA publications as a source of canning instructions by income

Survey Question	Income						Chi-Square	
	<\$39,000		\$40,000-\$79,999		>\$80,000		x ²	p value
Where did you get the home-canning instructions you used in canning or preserving in the last 12 months?	n	(%)	n	(%)	n	(%)	6.4	0.041*
USDA publications	3	17	10	55	5	28		
Not from USDA publications	21	42	25	50	4	8		

* p-value < 0.05 was considered significant

Table 29 Frequency of using manufacturer of pressure cooker/canner as source of canning instructions by age category

Survey Question	Age				Chi-Square	
	18-60		>60		x ²	p value
Where did you get the home-canning instructions you used in canning or preserving in the last 12 months?	n	(%)	n	(%)	7.4	0.007*
From manufacturer of pressure cooker/canner	1	7	13	93		
Not from manufacturer of pressure cooker/canner	34	46	40	54		

* p-value < 0.05 was considered significant

Table 30 Frequency of using family members or friends as a source of canning instruction by employment

Survey Question	Employment Status				Chi-Square	
	Employed		Unemployed		x ²	p value
Where did you get the home-canning instructions you used in canning or preserving in the last 12 months?	n	(%)	n	(%)	5.11	0.024*
Family members or friends	7	27	19	73		
Not from family members or friends	33	53	29	47		

* p-value < 0.05 was considered significant

Table 31 Frequency of using family members or friends as a source of canning instruction by education

Survey Question	Level of Education				Chi-Square	
	High school or less		Some college or a 2 year college degree		4 year college degree and/or post-graduate/professional school	
	n	(%)	n	(%)	n	(%)
Where did you get the home-canning instructions you used in canning or preserving in the last 12 months?						
Family members or friends	8	31	12	46	6	23
Not from family members or friends	9	15	20	32	33	53

* p-value < 0.05 was considered significant

Freezing

Overall, 89% of survey participants froze food that they grew or bought and packaged or repackaged in the 12 months prior to the survey. The most common reason for freezing food at home was to preserve garden produce (66%) (Table 32). Other reasons often chosen were to save money (60%), small family size (40%), prefer home frozen quality and/or flavor (38%), and to save time (35%).

Table 32 Reasons for participation in freezing among individuals who froze food at home

Why did you or your family freeze food at home? (Check all that apply) (n=104)	n (%)
Preserving garden produce	69 (66%)
Save money	62 (60%)
Small family size	41 (40%)
Prefer home canned quality and/or flavor	39 (38%)
Save time	36 (35%)
Other	13 (13%)
Like to create recipes	11 (11%)
Health reasons	11 (11%)
Canning takes too much time	8 (8%)
Canning scares me	5 (5%)

Fifty percent of home freezers used the Ball Blue Book for freezing instructions, making it the primary source (Table 33). Additionally, 42% used state or university extension service

publications, 37% relied on their own experience, and 30% received instruction from friends or family members.

Table 33 Source of freezing instructions used in preserving among individuals who froze food at home

Where did you get the home-canning instructions you used in canning or preserving in the last 12 months? (Check all that apply) (n=90)	n (%)
Ball Blue Book	52 (50%)
State or University Extension services	44 (42%)
Experience	38 (37%)
Family members or friends	31 (30%)
USDA publications	21 (20%)
General cookbook	15 (14%)
Directions from manufacturer of freezing equipment and supplies	11 (11%)
Trial and error	10 (10%)
National Center for Home Food Preservation website	8 (8%)
Other	5 (5%)
Magazines or newspapers	4 (4%)
Television	3 (3%)
Other internet sites	1 (1%)
Don't know	1 (1%)

The typical storage time of food left in the home freezer was 3 to 6 months among 30% to 9 to 12 months among 26% of individuals who froze food at home (Table 34). Seventy-seven percent of individuals participating in home freezing do not keep a written or electronic inventory of foods they have preserved through freezing while 10% stated they did keep an inventory and 13% did sometimes (Table 35).

Table 34 Length of food storage in the home freezer

How long do you typically store food in your home freezer? (n=103)	n (%)
3 to 6 months	31 (30%)
9 to 12 months	27 (26%)
6 to 9 months	16 (15%)
Over 12 months	15 (15%)
0 to 3 months	11 (11%)
Don't know	3 (3%)

Table 35 Maintenance of a written or electronic inventory for food in the home freezer

Do you keep a written or electronic inventory of foods in your home freezer? (n=104)	n (%)
No	80 (77%)
Sometimes	14 (13%)
Yes	10 (10%)
Don't know	0 (0%)

A variety of foods were packaged and frozen including vegetables (78%), meat (74%), fruits (69%), breads and bakery products (67%), and home prepared foods (65%) (Table 36). Meat was frozen at home in the highest quantity. An average of 53.6 pounds of meat was frozen for the year. Focusing specifically on home prepared foods, quick breads, cookies, cakes, or other pastries (77%), and main dishes including meat (66%) were the most frequent items frozen (Table 37).

Table 36 Frequency and quantity of foods packaged and froze at home

Did you package and freeze any of the following foods in the last 12 months? If so, approximately how many pounds did you package and freeze? If you didn't freeze the particular kind of food, put zero. (n=102)	Pounds (average)	n (%)
Vegetables	11.5	80 (78%)
Meat	53.6	75 (74%)
Fruits	8	70 (69%)
Breads and bakery products	9.4	68 (67%)
Home prepared foods (casseroles, soups, etc.)	8.5	66 (65%)
Fish	7.6	47 (46%)
Wild game	14.8	22 (22%)
Jams, jellies, or preserves	0.6	10 (10%)

Table 37 Home prepared foods frozen at home

Did you freeze any of the following home prepared foods in the last 12 months? (Check all that apply) (n=90)	n (%)
Quick breads, cookies, cakes, or other pastries	69 (77%)
Main dishes, including meat	59 (66%)
Pies	33 (37%)
Other desserts	31 (34%)
Main dishes without meat	26 (29%)
Vegetable dishes	20 (22%)
Fruit dishes	14 (16%)
Other	10 (11%)
Sandwiches	4 (4%)

Many different packages were utilized for freezing foods. Ninety-four percent of participants used heavy duty/freezer plastic bags, 50% rigid plastic containers, 27% aluminum foil, 27% glass jars, 23% vacuum packaging, and 23% freezer paper (Table 38).

Table 38 Packaging used for freezing foods at home

What types of packaging did you use for foods you froze in the last 12 months? (Check all that apply) (n=104)	n (%)
Heavy duty/freezer plastic bags	98 (94%)
Rigid plastic containers	52 (50%)
Glass jars	28 (15%)
Aluminum foil	27 (15%)
Vacuum packaging	24 (11%)
Freezer paper	24 (3%)
Regular/storage plastic bags	15 (14%)
Milk, cottage cheese or soft margarine containers	13 (13%)
Other	9 (9%)
Don't know	0 (0%)

When asked if they blanched vegetables prior to freezing, 27% indicated they did not. Of those who did blanch, 97% used boiling water and 9% used steam (Table 39). When specifically discussing corn-on-the-cob, 59% of individuals did blanch it prior to freezing while 38% of individuals did not blanch it (Table 40).

Table 39 Method used to blanch vegetables prior to freezing

If you blanched vegetables prior to freezing which method did you use? (Check all that apply) (n=67)	n (%)
Boiling water	65 (97%)
Steam	6 (9%)
Microwave	2 (3%)

Table 40 Frequency of blanching corn-on-the-cob prior to freezing

If you froze corn on the cob in the last 12 months, did you blanch it prior to freezing? (n=61)	n (%)
Yes	36 (59%)
No	23 (38%)
Don't know	1 (2%)
Other	1 (2%)

Ninety-one percent of participants did not have any foods they froze in the previous 12 months spoil (Table 41). However, 7% of those participating in home freezing did have some level of spoilage in their frozen food.

Table 41 Occurrence of spoilage in foods frozen at home

Did any of the foods you froze in the last 12 months spoil? (n=104)	n (%)
No	95 (91%)
Yes	7 (7%)
Don't know	2 (2%)

Participant Preferences and Beliefs

Seventy-seven percent of participants reported they would be interested in receiving information regarding home food preservation from the OCES. The main method of communication desired to obtain this information was through printed materials (fact sheets, newspapers, newsletters) (77%) (Table 42). In addition to print, 42% of participants would like to receive information through the internet, 31% through email, and 22% through means of the television.

Table 42 Desired method for receiving home food preservation information from Oklahoma Cooperative Extension Service

How would you like to receive information from the Oklahoma Cooperative Extension Service? (Check all that apply) (n=91)	n (%)
Print	70 (77%)
Internet	38 (42%)
Email	28 (31%)
Television	20 (22%)
Facebook	7 (8%)
Other	6 (7%)
YouTube	4 (4%)

The final question on the research survey asked participants if they believed canned and/or frozen food could be part of a healthy diet, or if it was better to choose fresh fruits and

vegetables. Most respondents believed that canned and/or frozen fruits and vegetables could be part of a healthy diet (73%). Many individuals did, however, state that fresh produce was the better option in terms of nutritional value (24%). Participants commonly mentioned several barriers to year round consumption of fresh fruits and vegetables including a decreased availability of fresh produce out of the growing season as well as in rural areas, and an increased price of fresh, especially when home canned and/or frozen food is available from the excess produce utilized during the growing season.

CHAPTER V

DISCUSSION, SUMMARY, AND CONCLUSION

Discussion

Participation in home canning and freezing was relatively high among OHCE members who completed the survey, 77% and 89% respectively. Participation in home canning was more than triple that of the national average (22%) (D'Sa et al., 2007). The national average was determined through use of a telephone survey which sought to determine home canning practices and safety issues in the U.S. during 2004. There were potential factors which could have contributed to the higher rates of home food preservation among the study population. Because OHCE is an organization within OCES, the participants may have been exposed to more opportunities related to food preservation such as home canning workshops given throughout counties in Oklahoma. The majority of participants grew, raised, hunted, or fished for their own food (72%). Sixty-four percent of participants got the fruits and vegetables used for canning and freezing from their home garden (Table 3). Producing food in one form or another requires care, effort, and time. This may have increased the likelihood of preserving food at home so the food would not be wasted. In support of this were numerous participants who stated preserving garden produce as a contributing factor to canning and/or freezing. Older OHCE members could have been more likely to have practiced home preservation out of necessity earlier in their lives and may have continued due to preference for flavor/taste or personal and/or family expectations.

Cost savings and preferred quality were among the primary factors that contributed to home canning and freezing (Table 2). Producing one's own food at a perceived minimal cost, compared to purchasing it at the store, and knowing where the food came from may have attributed to the high prevalence of cost savings and preferred quality as reasons for home preservation. Additionally, there was a significant difference in cost savings as a factor contributing to home canning or freezing by income (Table 4). Individuals in the low (<\$39,000) and middle (\$40,000-\$79,000) income categories were more likely to have chosen cost savings as a reason to preserve food at home. Along the same lines, there was a significant difference between report of home canning by income as well as saving money as a reason for canning by income (Table 23 and 25, respectively). Again, participants in the low (<\$39,000) and middle (\$40,000-\$79,000) income categories were more likely to can and choose saving money as a reason they did so. Most of the survey participants fell into the low (<\$39,000) and middle (\$40,000-\$79,000) income categories (78%). These factors could have been additional reasons for the increased prevalence of home food preservation among the study population.

The source of canning instructions was highly variable depending on age, employment status, and income. Participants between the ages of 18 and 60, employed, and in the middle (\$40,000 - \$79,000) to high (>\$80,000) income category were significantly more likely to get canning instructions from USDA publications (Table 26, 27, and 28, respectively). This population was more apt to have access to and use the internet compared to older adults who had a lower income and were not employed (Fox, 2004; Hogeboom et al., 2010). Though available for purchase in print, USDA publications such as the *Complete Guide to Home Canning* are readily available online at no charge. The complete guide may be downloaded through the NCHFP website (NCHFP, USDA publications). Therefore, greater utilization of recommended USDA publications by younger adults who were employed and who had higher incomes might have been due to their increased use of the internet in comparison to older adults who were not

employed and had a lower income. Participants who were unemployed and had a two year college degree or less were significantly more likely to utilize family members or friends as a source of canning instructions compared to those who were employed or had a four year college degree or more (Table 30 and 31, respectively). Family members or friends' might provide preservation instructions that were not scientifically tested and recommended for use or which were out of date and no longer recommended for safety and/or quality reasons. This data suggested employed individuals were more likely to use a recommended source for canning instructions while unemployed individuals were more likely to use a source that was questionable.

Use of recommended methods is important when canning food at home. It is also important to not alter recipes in any way (USDA, 2009). Twenty-seven percent of participants modified some, or all, of the recipe which could allow for production of potentially hazardous food products and increase the probability of food loss.

The primary methods used for canning fruits and/or tomatoes were boiling-water bath (95%) and pressure canner (21%) (Table 10). These methods are recommended for canning fruits and/or tomatoes. However, 18% of individuals utilized open kettle processing which does not provide sufficient heat to kill all pathogens and is not recommended (Andress et al., 2006). Food which was open kettle canned could potentially harm the individuals consuming it. All vegetables, unless pickled, are low acid foods and require pressure canning for safe preservation (Andress et al., 2006). Though pressure canning was the primary method used when canning vegetables (57%), 49% percent of participants who canned vegetables used a boiling-water bath (Table 11). It is possible this number was high because of the way the question was worded. Participants may have included pickled products when choosing what method they used to can "vegetables". Because acid is added or formed during pickling, use of a boiling-water bath is sufficient to safely preserve pickled vegetables (Andress et al, 2006).

Proper adjustments for altitude must be made, when necessary, to ensure a safe home canned product (Andress et al., 2006). Most foods require adjustments in boiling-water and pressure canner processing times at an elevation greater than 1000 feet above sea level. Roughly half of Oklahoma is at altitudes greater than 1000 feet (NETSTATE, 2011). In general individuals canning food west of the I-35 corridor which runs north/south through center of the state need to make adjustments for altitude. Oklahoma City and Lawton are among cities that require adjustments to be made while Tulsa and Stillwater do not. Fifty-nine percent of participants canning vegetables and 46% canning fruits and/or tomatoes indicated it was not necessary to make adjustments for altitude where canning was done (Table 13 and 14). While some individuals did make adjustments (18% to 21%), about the same number did not and were unaware if altitude adjustment was necessary (23% to 29%). Many participants could have been correct in stating that an adjustment was not necessary. However it is likely that some of these individuals, as well as those who were unaware if an adjustment was necessary, did need to make adjustments when canning food at home. The Ball Blue Book was the number one source for canning instructions (Table 7). Unfortunately, recommendations for adjustments in altitude are not easily found in the Blue Book compared to other publications such as the USDA *Complete Guide to Home Canning* or *So Easy to Preserve* by the Cooperative Extension Service at the University of Georgia (USDA, 2009; Andress et al., 2006). This could have impacted awareness of the necessity of altitude adjustments in locations greater than 1000 feet above sea level.

About a third of home canners reported sealing failure in at least one jar. Factors contributing to failed seals include use of metal lids that were old (> 5 years from date of manufacture), dented, or had other malformations (USDA, 2009). If the jar-sealing surface is not properly cleaned before placing on the metal lid to process food or if the lids are over- or under-tightened prior to processing or retightened post processing, sealing failure could occur. Recommended options when dealing with an unsealed jar include reprocessing contents within 24

hours, freezing jars, or placing food in refrigerator and consuming within three days. All participants who experienced sealing failure reported following one or more of those procedures (Table 18).

Most home canners were able to identify common signs of spoilage including bulging lids, leakage, mold, off-odor or color, and spurting liquid when a container is opened (Table 20). However, 53% indicated flavor was an indication of spoilage. It is recommended that people not consume any food that is at risk of spoilage (Andress et al., 2006). The frequent choice of flavor as a sign of spoilage could have been associated with the 40% of home canners who reported there would always be signs of spoilage or, they did not know if there would always be a sign of spoilage. However, the potentially deadly toxin produced by *Clostridium botulinum* is not visible to the naked eye and portrays no other signs of its presence (Andress et al., 2006). Use of a method which is not recommended during preparation or processing, equipment problems, and/or alteration of the original recipe would increase potential food safety risks in low acid foods because harmful microorganisms or their toxin could remain. This gap in knowledge related to spoilage and the safety of home canned foods could create harmful, potentially deadly, situations if at risk food was consumed.

Most participants (89%) had frozen food they grew or bought and packaged or repackaged during the previous 12 months. The most common reasons cited for freezing food at home were to preserve garden produce (66%) and save money (60%) (Table 32). Both correlated with results reported as reasons for home canning. The high prevalence of OHCE members who grew, raised, hunted or fished for their own food could have contributed to the large number of individuals who froze food at home. Small family size was an additional factor commonly chosen as a reason for freezing (40%) (Table 32). Most survey participants lived in a three person or less household (85%) (Table 1). This also may have impacted the number who froze food at home. These individuals may have been more apt to freeze food if large meals were prepared and there

were leftovers which could not be eaten in a short time. If food was purchased at a reduced price or in bulk, individuals in smaller sized households may have repackaged and frozen it to reduce waste.

The Ball Blue Book was the most common source of canning instructions and remained so for freezing instructions (50%) though use of family members or friends (30%) and one's own experience (37%) were more prevalent sources among individuals freezing food at home (Table 33). Unlike home canning, freezing food without following recommended procedures does not pose as significant a risk in terms of food safety (Andress et al., 2006). The blanching process recommended for most vegetables aids in removing bacteria left on the surface of vegetables, and the extreme cold temperature at which frozen food is held does not allow for growth of most microorganisms. However, as previously mentioned it is necessary to use proper packaging and freezing methods, such as blanching and moisture vapor proof packaging, to ensure the highest quality product, achieve maximum freezer storage, and decrease risk of foodborne illness.

Blanching vegetables prior to freezing deactivates enzymes, helps maintain the integrity of the vegetable, and cleanses it of soil and microbes left behind after washing (Andress et al., 2006). While most participants' blanched vegetables prior to freezing, 27% did not (Table 39). Those who did not blanch vegetables could have a loss of nutrition, quality, and product resulting in wasted time and money spent on food and energy costs to maintain it in the freezer (Andress et al., 2006). When asked if blanching took place prior to freezing fresh corn-on-the-cob, 38% stated they did not blanch. If corn-on-the-cob is not properly blanched, a soft rubbery texture and cob like flavor could result (Botzek-Linn, 2011). Corn must be immediately cooled after processing to stop continued cooking of the starch and to prevent the noted changes from occurring. Deciding not to blanch corn-on-the-cob may result in a greater loss of product and quality. Enzymes present in corn will not be deactivated and a continued deterioration of color, flavor, and texture will take place. Reasons for not blanching other vegetables for freezing may have been a result of

lack of knowledge and/or education. Common sources of freezing instructions used by the participants, such as family members and/or friends or personal experience; may not provide recommended methods for preserving vegetables. The complimentary handout given to the survey participants provided recommended blanching method for freezing fresh corn-on-the-cob. Considering vegetables were the main food to be frozen by participants (78%) (Table 36), this has potential to not only increase knowledge on proper methods for freezing corn but could additionally increase awareness that recommended preservation methods exist for freezing vegetables. If the participants were interested in additional information, the handout provided references to access home canning and freezing recommendations.

The longer frozen food is stored the higher the costs to maintain it in the frozen state (Kendall et al., 2008). Fifteen percent of participants stored frozen foods longer than 12 months and 26% for 9 to 12 months (Table 34). As mentioned, saving money was a primary motive behind participation in freezing food at home. Education on proper storage times may decrease the cost per item of food stored. Labeling food with a date and description of the product may improve turnover of freezer contents (Andress et al., 2006). Additionally, keeping a written or electronic inventory of frozen items could decrease the time food is stored and aid in cost reduction. However, only 10% of survey participants consistently kept an inventory of foods (Table 35).

The majority of participants, 77%, stated they were interested in receiving information regarding home food preservation from OCES. The primary method of choice for information was print (77%), followed by internet (42%), and email (31%) (Table 42). The desired method for receiving home food preservation materials could have been influenced by the demographic makeup of the study population. As mentioned, older adults who are not employed have a lower usage of the internet (Hogeboom et al., 2010). Also, older adults have the highest rates of disabilities compared to any other age group; this could create barriers and withhold them from

accessing online sources (Fox, 2004). Both of these factors could have influenced the desired method for receiving information and subsequently increased the preference for print materials.

Participants correctly indicated that canned and/or frozen vegetables could be part of a healthy diet. Those who stated that fresh was best were not inherently wrong; however improper handling and storage of produce can invalidate this statement. Rickman and colleagues (2007a; 2007b) two part review compared the nutritional value of fresh, frozen, and canned fruits and vegetables. Fresh produce does initially have the highest nutritional value but quickly begins to lose some of this during prolonged storage. On the other hand, canned and/or frozen fruits and vegetables lose minimal amounts of nutrients with extended storage. Therefore, properly preserved frozen and/or canned fruits and vegetables may have an increased amount of certain nutrients compared to their “fresh” counterpart if not eaten shortly after harvest.

Summary

The purposes of this study were to determine the prevalence of home canning and freezing in Oklahoma, whether those surveyed used recommended processing procedures, and the preferred method(s) for accessing current researched-based home food preservation information.

Null hypothesis one stated survey participants do not preserve food though canning at home. Seventy-seven percent of individuals reported canning food at home. Consequently, null hypothesis one is rejected.

Null hypothesis two stated survey participants do not use safe and recommended canning methods. Most participants did use safe and recommended methods for canning fruits and/or tomatoes and vegetables. However, a portion of participants reported using methods which are not recommended and therefore we fail to reject null hypothesis two.

Null hypothesis three stated survey participants who canned food at home did not experience sealing failures or other forms of spoilage. Thirty-four percent of individuals had at least one jar that did not seal properly and 8% had a home canned food that spoiled. Consequently, null hypothesis three is rejected.

Null hypothesis four stated survey participants who canned food at home were not able to identify signs of spoilage in canned food. All participants were able to identify at least one sign of spoilage in canned foods. However, 53% incorrectly indicated flavor as a sign of spoilage. Tasting food that is at risk for spoilage could cause harm to the individual consuming it. Therefore, we fail to reject null hypothesis four.

Null hypothesis five stated survey participants do not preserve food through freezing. Eighty-nine percent of participants froze food at home. Therefore, null hypothesis five is rejected.

Null hypothesis six stated survey participants do not use recommended freezing methods or procedures to maximize quality, nutrition and storage time. Not all participants used recommended sources for freezing methods. Some participants' stored food for greater than a year, used packaging not recommended for freezing food, and did not blanch vegetables prior to freezing. Because, though many, but not all participants used methods and procedures to maximize quality, nutrition, and storage time, we fail to reject null hypothesis six.

Null hypothesis seven stated survey participants will not be interested in additional information on home food preservation. Seventy-seven percent of participants were interested in additional information but 23% were not. Since not all participants were interested, we fail to reject null hypothesis seven.

Null hypothesis eight stated survey participants will continue to prefer traditional methods, technologies and sources to obtain information on home canning and freezing recommendations. Seventy-seven percent of participants desired to receive information through

the traditional method of print materials. However, a portion of participants desired to receive materials through updated technologies such as the internet, email, and Facebook. Because many participants still wished to receive information through traditional methods, we fail to reject null hypothesis eight.

Conclusion

Preserving food through canning or freezing was a common activity among OHCE members who participated in the research survey. Though many used a recommended source for instructions and method of preservation, those who did not put themselves and individuals consuming their home preserved food at risk for foodborne illness and increased the probability of food loss from spoilage and lower quality. Whether canning or freezing as a means of food preservation, use of proper methods in each step of the process cannot be stressed enough. For this population, print materials may be the most desirable way to educate though use of the internet should be continued.

Recommendation

Proper knowledge of when and how to can and/or freeze food at home, should be a goal of home food preservation education efforts. This would not only contribute to preservation of a safe product with maximum quality and shelf life but one that contains the highest nutritional benefits possible. Focus should be placed on the proper canning and freezing methods for specific food items. This includes the necessity of adjusting for altitude when canning all foods and blanching vegetables prior to freezing. Print materials in the form of fact sheets, newsletters, and brochures should be used to distribute information to OHCE members and others. Clientele who

opt for printed materials must be educated on their responsibility to ensure the copy, used at the time of preservation, contains current recommendations. Conversely, since over a third of individuals were interested in receiving information through internet or email, it would be of benefit to distribute information through these modes of communication as well. Finally, education offered on the nutritional benefits of canned and/or frozen fruits and vegetables may encourage individuals to consume them. Education, instead of efforts to eliminate barriers to year round consumption of fresh produce, may have an impact on increasing fruit and vegetable intake among consumers.

Implications for Future Research

Due to the limitations of this study, results cannot be generalized to all residents in Oklahoma. Repetition of this research survey with a more comprehensive sample would be beneficial to understanding the current home canning and freezing practices among Oklahomans. While print materials could be the communication form of choice to receive information and subsequently educate individuals on recommended preservation methods, it would be helpful to determine the preferred method for receiving information across all populations. In line with this, knowing who has access to and is using the internet could allow more specific means of reaching targeted populations. It would also be of interest to know if education and knowledge of proper preservation techniques would contribute to an increased use of recommended methods or if individuals would continue to use recipes which are not recommended, such as those that are outdated or have come from relatives and/or friends. Determining if differences exist in these areas among older adults who have canned and/or frozen food for many years compared to those new to home food preservation would aid in formation and distribution of educational materials.

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APPENDICES

APPENDIX A

OSU INSTITUTIONAL REVIEW BOARD APPROVAL

Oklahoma State University Institutional Review Board

Date: Friday, May 20, 2011
IRB Application No HE1129
Proposal Title: Survey of Home Canning and Freezing Practices among Oklahoma Home and Community Education Organization Members

Reviewed and Processed as: Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 5/19/2012

Principal Investigator(s):

Jessica Morath	Barbara J. Brown
301 HES	301 HES
Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,



Shelia Kennison, Chair
Institutional Review Board

APPENDIX B

RECRUITMENT SCRIPT

Home Canning and Freezing Survey

Recruitment Script

Hello my name is Jessica Morath and I'm a graduate student at Oklahoma State University. Currently I'm working on a research project which hopes to gain more insight on the status of home canning and freezing in Oklahoma. I would highly appreciate if you could take 30 minutes of your time to fill out my research survey to help in completion of this study. Along with the survey is a paper concerning the details of your participation in this project. You are welcome to keep this information sheet for your records. If you have questions at any time while completing the research survey please feel free to ask me. Also, if in the future you have questions concerning the project, you may get in touch with me by using the contact information on the information sheet. Through completion of this research survey you are giving your consent to participate. Thank you for your attention.



APPENDIX C

PARTICIPANT INFORMATION SHEET

Home Canning and Freezing Survey

Participant Information Sheet

To be read by or to the participant before the survey is completed:

In order for the Oklahoma Cooperative Extension Service (OCES) to be able to determine the prevalence of home canning and freezing in Oklahoma and whether or not people are using recommended processing procedures, we would like you to participate in this research survey. The information you provide will aid the OCES in development of canning and freezing materials and methods to best distribute these to residents of Oklahoma.

Your participation in this research survey is voluntary and your responses will remain confidential. No part of the survey will allow us to identify the person completing it or at what time it was completed. You may cease participation at any point while taking the research survey. There are no risks associated with completion of this research survey beyond that in which you can encounter in day to day living.

There is not an immediate benefit to you for filling out this research survey and you will not be compensated for your time which assists us to complete this study.

All records of the study will be kept private. Written results concluded from the research surveys will emphasize group findings. No information will be given that could lead to your identification. Data will be stored in a locked closet at Oklahoma State University in the College of Human Sciences, room 002, for five years. Only the researchers and those involved in research oversight will have access research records. It is possible that the research oversight staff, which is committed to the protection of your rights and well being as a research participant, will monitor the consent process and data collection period.

If you have any questions concerning the research survey or your participation in this study, please contact:

Jessica Morath, Masters Candidate
Oklahoma State University Department of
Nutritional Sciences
301 Human Environmental Sciences
Stillwater, OK 74078
(405)744-5040

Barbara Brown, Ph.D., R.D./L.D.
Food Specialist, OCES and Associate
Professor, Dept. of Nutritional Sciences
301 Human Environmental Sciences
Stillwater, OK 74078
(405)744-6940

If you have questions about you rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 210 Cordell North, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

Through completion of this survey you are giving your consent. Thank you for your help to enhance the quality of future programs.

APPENDIX D

SURVEY HANDOUT

How to freeze corn:



Method: Blanching is necessary for most vegetables, including corn, which are to be frozen. By heating vegetables for a short time in boiling water or steam, the enzymes present are deactivated contributing to enhanced flavor, color and texture. It also cleanses the vegetables and decreases the loss of vitamins. Blanching vegetables for the specified time is crucial. Underblanching can increase enzyme activity making it worse than no blanching at all. Overblanching can may impair flavor and nutrient content.

Water blanching: Obtain a blancher with a basket and lid or make your own by placing a wire basket into a large pot with a lid. One gallon of water to one pound of vegetables is necessary. Bring water to a boil and place vegetables into basket. Place basket in water and cover. Begin blanching time once water has returned to a boil (should be within one minute, if more there are too many vegetables for the amount of water). Heat for specified time on high. Once blanching time is completed vegetables must be quickly cooled. Remove basket from the pot and plunge it into a large bowl of cold water, 60°F or below. Change water/ice water frequently as needed. Cooling time should be similar to blanching time. After completely cooled thoroughly drain vegetables.

Preparation: Select corn that is tender and recently harvested. Remove husk and silk, trim ends as necessary and wash.

Corn-on-the-Cob: Water blanch small ears (1-1/4 inches or less in diameter) 7 minutes, medium ears (1-1/4 to 1-1/2 inches in diameter) 9 minutes, and larger ears (over 1-1/2 inches in diameter) 11 minutes. Cool quickly, drain and package, then seal and freeze

Whole Kernel Corn: Water blanch for 4 minutes. Cool, drain and cut kernels from cob at about 2/3 the depth of the kernels. Place in package and leave a 1/2-inch head space; seal and freeze.

Cream Style Corn: Water blanch for 4 minutes. Cool, drain and cut kernel tips. Scrape the cobs using the back of a knife to remove juice and the heart of the corn. Place in package and leave a 1/2" head space; seal and freeze.



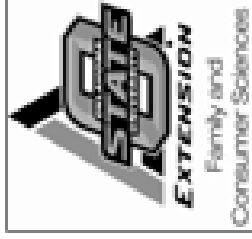
Home Canning and Freezing Resources:

- National Center for Home Food Preservation: <http://www.uga.edu/nchfp/>
- Local Oklahoma State University Cooperative Extension Office

Oklahoma State University, U. S. Department of Agriculture, State and Local governments cooperating. Oklahoma State University in compliance with Title VI and VII of the Civil Rights Act of 1964, Executive Order 11246 as amended, Title IX of the Education Amendments of 1972, Americans with Disabilities Act of 1990, and other federal and state laws and regulations, does not discriminate on the basis of race, color, national origin, gender, age, religion, disability, or status as a veteran in any of its policies, practices, or procedures.

APPENDIX E

POSTER



Home Canning and Freezing Survey



Please participate in this survey to help Oklahoma Cooperative Extension Service develop home canning and freezing materials to best meet your needs!

APPENDIX F

RESEARCH SURVEY

Home Canning and Freezing Survey



Please participate in this survey to help
Oklahoma Cooperative Extension Service
develop home canning and freezing materials
to best meet your needs!



Home Canning and Freezing Survey

Thank you for taking time to complete this survey on home canning and freezing practices.

Please place a check next to the answer that best represents how you and your family can and freeze foods at your home. This survey will take approximately 15 minutes to complete.

Section 1: Canning Food at Home

1. Did you can any foods in the last 12 months? (If your answer is no or don't know, skip to question 24, page 7.)
 - Yes
 - No (skip to question 24, page 7)
 - Don't know (skip to question 24, page 7)

2. Why did you or your family can food at home? (Check all that apply.)
 - Save money
 - Prefer home canned quality and/or flavor
 - Health reasons
 - Like to create recipes
 - Other _____

3. Where did you get the home-canning instructions you used in canning or preserving in the last 12 months? (Check all that apply.)
 - USDA publications
 - State or University Extension service publications
 - General Cookbook
 - Ball Blue Book
 - Magazines or Newspapers
 - Family members or friends
 - Directions from manufacturer of pressure cooker/canner
 - Directions from manufacturers of jars/lids
 - National Center for Home Food Preservation website
 - Other internet sites
 - Television
 - Don't know
 - Other _____



4. Did you follow the canning instructions as written or did you modify any of them?
- Used recipes as written
 - Modified some or all of them
 - Don't know
5. Which of the following did you can in the last 12 months? (Check all that apply.)
- Fruit
 - Tomatoes or tomato products
 - Vegetables
 - Pickles
 - Jams, jellies or preserves
 - Meat, poultry or fish
 - Other _____
6. Did you use artificial sweeteners in any of the following home canned foods? (Check all that apply.)
- No, did not use artificial sweeteners
 - Jams, jellies or preserves
 - Fruits
 - Pickles, relishes
 - Salsas
 - Don't know
 - Other _____
7. Which of the following methods did you use to can fruits and/or tomatoes in the last 12 months? (Check all that apply.)
- Boiling-water bath (food is packed in hot or cold jars and the filled jars are heated in boiling water without pressure)
 - Pressure saucepan or cooker (not large enough to hold at least 4 pint jars)
 - Pressure canner (larger than pressure cooker, holds at least 4 quart jars)
 - Oven
 - Open kettle (food is cooked in an uncovered pan, then packed in hot jars and sealed without further heating)
 - Steam canner
 - Other _____
 - I did not can fruits and/or tomatoes in the last 12 months



8. Which of the following methods did you use to can vegetables in the last 12 months? (Check all that apply.)

- Boiling-water bath (food is packed in hot or cold jars and the filled jars are heated in boiling water without pressure)
- Pressure saucepan or cooker (not large enough to hold at least 4 pint jars)
- Pressure canner (larger than pressure cooker, holds at least 4 quart jars)
- Oven
- Open kettle (food is cooked in an uncovered pan, then packed in hot jars or cans and sealed without further heating)
- Other _____
- I did not can vegetables in the last 12 months

9. Approximately how many pints of the following foods did you can in the last 12 months? If you didn't can the particular kind of food, put zero. 1 quart = 2 pints

- Fruits _____
- Tomatoes _____
- Other vegetables _____
- Cucumber pickles _____
- Other pickled vegetables _____
- Relishes or Chutney _____
- Salsas _____
- Jams, jellies or preserves _____
- Meat or poultry _____
- Don't know

10. Did you have the dial gauge on the pressure canner you used tested in the last 12 months?

- Yes
- No (skip to question 12, page 5)
- My canner does not have a dial gauge(skip to question 12, page 5)
- Did not use a pressure canner (skip to question 12, page 5)
- Don't know (skip to question 12, page 5)

11. Where did you have it tested?

- County Extension Service
- Mailed back to manufacturer
- Other _____
- Gauge was not tested
- Don't know



12. If you canned vegetables in the last 12 months, did you make adjustments for altitude?
- Did not can vegetables
 - Yes, made adjustment
 - No, did not make adjustment and unaware if adjustment is necessary
 - Adjustment not necessary where canning was done
 - Don't know
13. If you canned fruits and/or tomatoes in the last 12 months, did you adjust the boiling-water processing time for altitude?
- Did not can vegetables
 - Yes, made adjustment
 - No, did not make adjustment and unaware if adjustment is necessary
 - Adjustment not necessary where canning was done
 - Don't know
14. What type of acid did you add to each jar of home canned tomatoes in the last 12 months?
- I did not can tomatoes
 - Fresh squeezed lemon juice
 - Commercially prepared lemon juice
 - Vinegar, 5-6% acidity
 - Citric acid
 - Vitamin C
 - Other _____
 - I did not add an acid
15. What kind of jars did you use for home canning? (Check all that apply.)
- Jars designed for home canning with the 2 piece metal jar lid
 - Jars currently sold for home canning with other types of lids
 - Recycled jars originally sold containing other foods, such as peanut butter, coffee, salad dressing
 - Other type of jars _____
 - Don't know
16. Did you have any jars that did not seal properly in the last 12 months?
- Yes
 - No (skip to question 19, page 6)
 - Don't know (skip to question 19, page 6)



17. How many jars would you say did not seal properly? _____ Jars
18. What did you do with the jars that did not seal? (Check all that apply.)
- Reprocessed them within 24 hours of original canning
 - Reprocessed them after 24 hours of original canning
 - Put them in the refrigerator and ate the food within 3 days
 - Froze the contents
 - Threw them out
 - Other _____
 - Don't know
19. Which of the following methods do you use most often to prepare and serve home canned vegetables, such as green beans, carrots, or corn?
- Did not can vegetables
 - Serve as is with no further heating
 - Bring to a boil
 - Boil uncovered for 11 minutes or more
 - Heat until warm (whether in oven, microwave or on stovetop)
 - Use as an ingredient in other recipes
 - Steam
 - Other _____
 - Don't know
20. Did any foods you home-canned in the last 12 months spoil?
- Yes
 - No (skip to question 22, page 7)
 - Don't know (skip to question 22, page 7)
21. What kind of food was it that spoiled?
- Fruits
 - Vegetables
 - Tomatoes or tomato products
 - Jams, jellies, preserves
 - Pickles or relishes
 - Salsas
 - Meat or poultry
 - Other _____
 - Don't know



22. Which of the following signs might mean that home canned or commercially canned foods may be spoiled? (Check all that apply.)
- Bulging lid
 - Leakage
 - Mold
 - Off-odor
 - Off-color
 - Floating fruit or vegetable
 - Spurting liquid when container is opened
 - Flavor
 - Don't know
23. Could home-canned or commercially canned foods be spoiled without any sign of spoilage, or would there always be some sign of spoilage?
- Could be spoiled without any sign
 - Would always be some sign of spoilage
 - Don't know
24. Have you or do you plan to can food at home in 2011?
- Yes
 - No
 - Don't know
-

Section 2: Freezing Food at Home

25. Did you or anyone in your household freeze foods that you grew or bought and packaged or repackaged yourself in the last 12 months? This would include freezing any food that is repackaged from its original, unfrozen state. It would not include, for example, buying a package of chicken and just putting it in the freezer without repackaging.
- Yes
 - No (skip to Section 3, question 37, page 11)
 - Don't know (skip to Section 3, question 37, page 11)



26. Why did you or your family freeze food at home? (Check all that apply.)

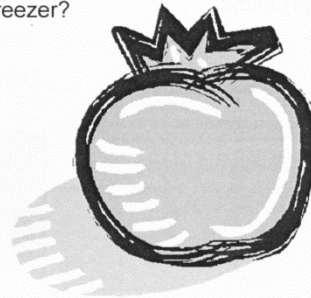
- Save money
- Save time
- Prefer home frozen quality and/or flavor
- Health reasons
- Small family size
- Like to create recipes
- Preserving garden produce
- Canning takes too much time
- Canning scares me
- Other _____

27. Where did you get the freezing instructions you used in the last 12 months? (Check all that apply.)

- USDA publications
- State or University Extension service publications
- General Cookbook
- Ball Blue Book
- Magazines or Newspapers
- Friends or family members
- Experience
- Trial and Error
- Directions from manufacturer of freezing equipment and supplies
- National Center for Home Food Preservation website
- Other internet sites
- Television
- Other _____
- Don't know

28. How long do you typically store food in your home freezer?

- 0 to 3 months
- 3 to 6 months
- 6 to 9 months
- 9 to 12 months
- Over 12 months
- Don't know





29. Do you keep a written or electronic inventory of foods in your home freezer?

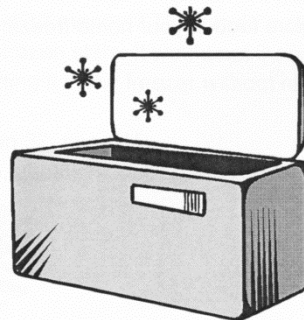
- Yes
- No
- Sometimes
- Don't know

30. Did you package and freeze any of the following foods in the last 12 months? If so, approximately how many pounds did you package and freeze? If you didn't freeze the particular kind of food, put zero.

- Breads and bakery products: _____ pounds
- Fruits: _____ pounds
- Vegetables: _____ pounds
- Jams, jellies or preserves: _____ pounds
- Home prepared foods (casseroles, soups, etc.): _____ pounds
- Meat: _____ pounds
- Fish: _____ pounds
- Wild game: _____ pounds

31. What types of packaging did you use for foods you froze in the last 12 months? (Check all that apply.)

- Regular/storage plastic bags
- Heavy duty/freezer plastic bags
- Freezer paper
- Aluminum foil
- Rigid plastic containers
- Glass jars
- Vacuum packaging
- Milk, cottage cheese or soft margarine containers
- Other
- Don't know





32. Did you freeze any of the following home prepared foods in the last 12 months? (Check all that apply.)

- Quick breads, cookies, cakes, or other pastries
- Pies
- Sandwiches
- Main dishes, including meat
- Main dishes without meat
- Vegetable dishes
- Fruit dishes
- Other desserts
- Other _____

33. If you blanched vegetables prior to freezing which method did you use?

- Did not blanch vegetables
- Microwave
- Boiling water
- Steam

34. If you froze corn on the cob in the last 12 months, did you blanch it prior to freezing?

- Yes
- No
- Don't know
- Did not freeze corn on the cob
- Other _____
- Don't know

35. Did any of the foods you froze the last 12 months spoil?

- Yes
- No (skip to question 37, page 11)
- Don't know (skip to question 37, page 11)

36. What signs of spoilage did you observe in these foods? _____



Section 3: General information: These responses will help us compare responses across different kinds of people.

37. What is your age?

- 18-40
- 41-60
- 61-75
- Over 75
- Prefer not to answer

38. What is your gender?

- Male
- Female
- Prefer not to answer

39. Were you employed outside the home during the summer in the last 12 months?

- Yes, full time
- Yes, part time
- No
- Prefer not to answer

40. What is the highest level of education you have completed?

- Less than high school graduate
- High school graduate or GED
- Some college or technical school
- 2 year college degree
- 4 year degree
- Post-graduate/Professional school
- Prefer not to answer

41. How many people lived in your household in the last 12 months? _____ people

42. How many of the people living in your household in the last 12 months were under age 18? _____ people



43. To what race or ethnic group do belong?

- White Non-Hispanic
- Hispanic
- African-American
- Asian/Pacific Islander
- Native American or Alaskan native
- Multi-racial
- Prefer not to answer

44. What was your total household income before taxes in 2009?

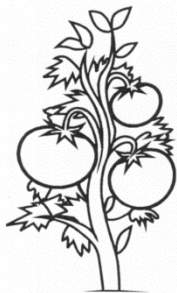
- Less than \$20,000
- \$20,000-\$39,999
- \$40,000-\$59,999
- \$60,000-\$79,999
- \$80,000-\$99,999
- Greater than \$100,000
- Prefer not to answer

45. What factors contributed to your participation in home food canning or freezing in the last 12 months? (Check all that apply.)

- Cost savings
- Quality
- Food safety
- Nutrition
- Other _____
- Did not can or freeze any food at home in the last 12 months

46. Did you or your family grow, raise, hunt or fish for any of your own food in the last 12 months?

- Yes
- No





47. Where did you get the fruits and vegetables you canned or froze at home in the last 12 months? (Check all that apply.)

- Home garden
- Farmer's market
- Garden of friend or relative
- Pick-your-own at a farm
- Grocery store
- Harvested from the wild
- Other _____

48. Would you be interested in receiving information regarding home food preservation from the Oklahoma Cooperative Extension Service?

- Yes
- No

49. How would you like to receive information from the Oklahoma Cooperative Extension Service? (Check all that apply.)

- Print (fact sheets, newspaper, news letter)
- Television
- Internet
- You tube
- Email
- Facebook
- Other _____

50. Do you believe canned and/or frozen foods can be part of a healthy diet or is it better to choose fresh fruits and vegetables?



Thank you for your time and participation. Please return survey to designated drop box.

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VITA

Jessica Morath

Candidate for the Degree of

Master of Science

Thesis: SURVEY OF HOME CANNING AND FREEZING PRACTICES AMONG
OKLAHOMA HOME AND COMMUNITY EDUCATION ORGANIZATION
MEMBERS

Major Field: Nutritional Sciences

Biographical:

Education: Completing the requirements for the Master of Science in
Nutritional Sciences at Oklahoma State University, Stillwater,
Oklahoma in May, 2012; completing the requirements for the Dietetic
Internship Program at Oklahoma State University, Stillwater, Oklahoma
in July, 2012; completed the requirements for the Bachelor of Science in
Nutritional Sciences at Texas A&M University, College Station, Texas
in May, 2010.

Experience: Dietetic Intern, August 2010 to July 2012; Employed by Oklahoma
State University as a Nutrition Graduate Assistant for the Department of
Campus Recreation at the Seretean Wellness Center, January 2011 to
December 2011.

Professional Memberships: American Dietetic Association, Oklahoma Dietetic
Association

Name: Jessica Morath

Date of Degree: May, 2012

Institution: Oklahoma State University

Location: Stillwater, Oklahoma

Title of Study: SURVEY OF HOME CANNING AND FREEZING PRACTICES
AMONG OKLAHOMA HOME AND COMMUNITY EDUCATION
ORGANIZATION MEMBERS

Pages in Study: 92

Candidate for the Degree of Master of Science

Major Field: Nutritional Sciences

Scope and Method of Study: Current home canning and freezing practices in Oklahoma are unknown. This study sought to determine the prevalence of home canning and freezing in Oklahoma, what processing procedures were taking place, and the preferred method for accessing current research-based home food preservation information. A convenience sample of Oklahoma Home and Community Education (OHCE) organization members who attended their state meeting in July 2011 in Oklahoma City was utilized for this study. Participants were asked to complete a research survey and return it to a designated area prior to leaving the conference. The research survey was divided into three sections: home canning practices, home freezing practices, and demographic information. Relative frequency tables and Chi-square statistics were utilized to analyze data.

Findings and Conclusions: Of the 220 research surveys distributed, 119 (54%) were returned and 117 were used in statistical analyses. The majority of OHCE members canned and froze food at home. Contributing factors to participation in home canning and freezing included cost savings, improved quality, utilization of home grown produce, and enjoyment. While many of the participants used instructions and preservation methods which were recommended, there was a large portion of individuals who did not use tested, research-based methods. Use of methods which are not recommended could produce unsafe products and potentially harm the individual who consumes the food. Most participants stated they would be interested in receiving information regarding home food preservation from the Oklahoma Cooperative Extension Service. The desired method for receiving information was as printed material followed, by internet. Limitations in the study design did not allow results to be generalized to all residents in Oklahoma. However, increased knowledge through education and distribution of materials on proper home canning and freezing methods is necessary among this population to ensure preservation of safe food products.

ADVISER'S APPROVAL: Dr. Barbara Brown
