A Guide to

FOOD STORAGE

FOR EMERGENCIES






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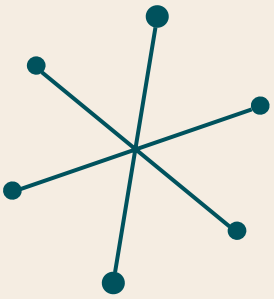

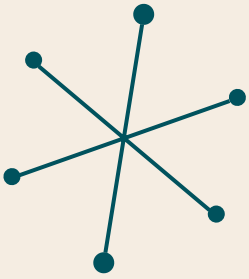

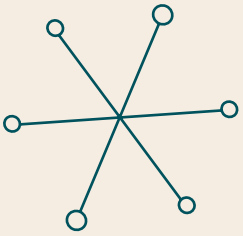


A Guide to FOOD STORAGE FOR EMERGENCIES

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FOREWORD

WHY EMERGENCY FOOD STORAGE?

dis·as·ter /di'zaster/ **Noun:** A sudden event, such as an accident or a natural catastrophe, that causes great damage or loss of life.

Disaster has many faces: earthquake, fire, hurricane, tornado, severe thunderstorm, winter storm, financial uncertainty, and more. Disasters can result in a disruption of the normal services we come to expect and sometimes take for granted. Examples are electricity, food, and water. Take for example Hurricane Katrina in Louisiana in 2005. The actual hurricane lasted only a few hours. It then took weeks to get electricity and water service back on for many residents. The same occurred for grocery stores. Then, it took several more weeks to re-establish food deliveries to stock the grocery stores. All-in-all, it may have taken several months to return the area to its basic services of food, water, and power. Residents were left to rely on outsider assistance. What if assistance was not available?

FEMA, the Federal Emergency Management Agency, advocates disaster preparedness. They advise people to be informed, make a plan, and prepare an emergency kit. A major part of that emergency kit is food and water for you and your family. But, what types of food should you store? How much food should you store? How will you cook it? Does it need to be refrigerated? How much water needs to be stored and how? Will these foods go bad during storage? Can my family or I become sick if we store these foods incorrectly? Can I throw these foods in my car in case I am forced to evacuate my home? These are all questions that you need to consider in both your planning and preparation stages.

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EMERGENCY FOOD STORAGE

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EMERGENCY FOOD STORAGE BASICS

INTRODUCTION

Earthquakes, fires, severe storms, and power outages are just some of the potential emergencies that can be encountered. Imagine that you have no electricity, no gas, no water, and no telephone service. What would happen if you were told to evacuate your home in the next 10 minutes? Imagine that all the businesses were closed and you were without any kind of emergency services. What would you do until help arrives?

The 3-Day Emergency Food and Water Supply is meant to be a quickly accessed, portable source of food and water that can sustain you and your family for several days. It should be stored in one or two containers for quick portability. The foods chosen should be ready to eat without the need for cooking or refrigeration (Eliason and Lloyd, 2005). Commercially canned foods are a good option because they don't require cooking or refrigeration. During short-term emergencies, you should be looking for calories and comfort foods. Don't worry about vitamins or even nutritional content for such a short period of time.

The 3-Week/ 3-Month Emergency Food and Water Supply Kits are meant for a disaster when food and water delivery may be interrupted. Hurricane Katrina is a perfect example of the normal delivery of food being interrupted. Build a small supply of food that is part of your normal, daily diet by purchasing a few extra items each week. Expand on this until you reach your goal. Not all of these foods will be ready to eat, and bulk foods must be added such as grains, beans, and dried milk. Plans must be made to store these foods and to provide the necessary means to prepare them. For medium-term emergencies you should look for calories and comfort foods like short-term emergency foods, but also make plans to sustain nutrition

from 3 weeks to 3 months. You should not worry too much about vitamin deficiencies since it will usually take more than 3 months to see symptoms. And, short-term vitamin deficiencies can be quickly reversed.

The Long-Term Food Supply is emergency foods sufficient for one or more years. It would take quite a disaster to last this long, but many feel this type of event is worth preparing for. Long-term food storage emphasizes a mixture of canned goods that can be safely stored for several years and low-moisture foods that can be safely stored for long periods (10-30 years). A year supply of basic food storage for one person is about 400 lbs wheat, 60 lbs dry beans, 60 lbs sugar, 16 lbs powdered milk, 10 qts oil, and 8 lbs salt (Eliason and Lloyd, 2005). This supply will provide enough calories for one person for one year, but may be lacking in calcium and vitamins A, C, B12, and E. Meeting complete nutritional needs in long-term food storage may require additional foods. For example vitamins A and C can be found in canned or bottled fruits and vegetables as well as in some fruit drink mixes. Vitamin B12 can be found in canned meats and beef jerky. Calcium can be found in powdered milks, hot cocoa, and pudding mixes. Vitamin E can be found in fats, oils, and nuts. A typical long-term food

supply for a family of four could weigh as much as 1500-2000 lbs. That's almost a "ton" of food! Vitamin deficiencies should be addressed when considering surviving off food storage for longer than 3 months. These foods must be stored along with equipment to prepare them (Eliason, Lloyd, 2005).

PLANNING

- Buy foods that you enjoy and are likely to eat.
- Slowly buy extra food each week until you have the amount of food storage desired.
- Plan meals so that there will be no leftovers in case there is no refrigeration.
- Each person should have 1 gallon of water per day for drinking, preparation of food, and personal hygiene. (May want to plan for more than this if you live in a hot climate, if someone is pregnant, or if someone is sick (Centers for Disease Control and Prevention, 2010)).
- Stock up on foods that you and your family enjoy and foods that are high in calories and good nutrition (FEMA, 2004)
- Preparing food becomes difficult when there is a loss of gas, electricity, and water. Have on hand cooking and eating utensils, paper plates, cups and towels, a manual can opener, a gas or charcoal grill (camp stove), and fuel for cooking, such as charcoal (Centers for Disease Control and Prevention, 2010).
- If you have pets, make sure to have a food and water supply for them as well (Red Cross, 2009).
- Avoid fatty, high protein and salty foods when your water supply is low (FEMA, 2004).
- Have a supply of soap and hand sanitizer to keep hands clean and to prevent sickness.
- Have a refrigerator thermometer.
- Each person should eat at least one meal per day.

STORAGE

- Food and water should be rotated every 6-12 months and use-by dates should be followed to ensure that they are safe to consume.
- Store canned goods in a dry, cool place, about 40-60°F to prevent spoiling (Centers for Disease Control and Prevention, 2010).
- Keep food protected from insects and rodents by storing in air tight containers (Centers for Disease Control and Prevention, 2010).
- Do not consume canned goods that have become swollen, dented, or corroded (Red Cross, 2009).
- In case of a power outage, eat foods in refrigerator first, then from the freezer, then from storage. In a well-insulated freezer, foods are usually good for 2 days if there are still ice crystals in the center of the food. Keep fridge and freezer doors closed as much as possible (FEMA, 2004)
- Make sure the fridge stays under 40° F. If the fridge is unopened, food will stay good for 4 hours (Seltzer, 2012).

SUGGESTED FOOD FOR MEDIUM AND LONG-TERM EMERGENCY STORAGE (Elliot, 2013)

Grains	Meats/Meat Alternatives	Fruits	Vegetables	Miscellaneous
Dry Cereal	Canned Tuna	Applesauce Packs	Canned Tomatoes	Bottled Water
Crackers	Canned Meat	Canned Fruit	Salsa	Cocoa Packets
Instant Potatoes	Canned Beans	Dried Fruit	Canned Vegetables	Pudding Cups
Instant Rice	Peanut Butter	Canned Juice		Non-fat Dried Milk
Instant Cereal	Beef Jerky	Fruit Roll-ups		Powdered Fruit Drinks
Canned Ravioli/ Spaghetti	Nuts	Jellies & Jams		Comfort Foods
Granola Bars	Canned Soup/Stew/Chili			
Chips	Kippered Snacks			

3-DAY EMERGENCY PORTABLE FOOD STORAGE

INTRODUCTION

When a disaster occurs, you will probably have no refrigeration, electricity, gas, water, sewage treatment, or telephone services. Local officials and relief workers cannot reach everyone immediately. Government officials and relief agencies usually take 72 hours to get set up (Herald CARES, 2010). This means you must have your own food, water, and other emergency supplies in sufficient quantity to last for at least 3 days. Don't skimp on quantities, since emergencies are not the time to go on a diet!

You probably will not have the opportunity to shop or search for the supplies you need. Storing high-energy, non-perishable, ready-to-eat food is necessary for short-term aid. Stress will be very high after a crisis, so be mentally ready for it. Stress, extra physical labor, and lack of sleep will also take its toll on your body, so high energy food is important. Even so-called "empty calorie" foods such as candy and other sugar-rich items are okay in these situations. Following a disaster, there may be power outages that could last for several days (Herald CARES, 2010).

WHAT FOODS GO INTO THE 3-DAY EMERGENCY SUPPLY?

Stock canned foods, dry mixes, and other staples that do not require refrigeration, cooking, water, or special preparation. Be sure to include a manual can opener and eating utensils (FEMA, 2012).

- Ready-to-eat canned meats, fruits, vegetables, and a can opener
- Protein or fruit bars

- Dry cereal or granola
- Peanut butter
- Dried fruit
- Nuts, chips, or crackers
- Food for infants
- Dry drink mixes to add to water
- Comfort/stress foods, candy bars, etc.

WHAT DRINKS (WATER) SHOULD GO INTO THE 3-DAY EMERGENCY SUPPLY?

- Bottled water
- Soda or juices (full sugar - not diet)
- Non-perishable pasteurized milk

HOW SHOULD THE 3-DAY EMERGENCY SUPPLY BE STORED?

In some cases, you may need to evacuate on short notice and take essentials with you. These foods should be stored in one or two portable containers. A perfect example is any storage

box with wheels and a handle. Be sure both containers fit into your vehicle. Keep your storage containers in an accessible place for easy access during an emergency. Make sure all family members know where the emergency food/water is kept (American Public Health Association, 2013).

HOW MUCH WATER DO I NEED?

You should store at least 1 gallon of water per person per day. A daily water intake of 3.7 L (approx. 1 gallon) for adult men and 2.7 L (approx. 3/4 gallon) for adult women is recommended. However, the requirement varies according to age, physical condition, activity, diet, and climate (Sawka, Cheuvront, Carter, 2005). Children, nursing mothers, and ill people need more water. The easiest and most reliable emergency supply is commercially bottled water. Keep bottled water in its original container and do not open it until you need to use it (FEMA, 2004).

MORE DETAILS ON FOODS TO STORE FOR EMERGENCIES

The emphasis is on low weight, compact (low volume), high calorie, minimal preparation, long shelf life, and good tasting foods that do not require refrigeration, cooking, water, or special preparation. Use foods from a refrigerator and freezer at the beginning of the emergency. Refrigerated foods are safe for 4 hours after removing them from refrigeration (Van, 2011). After that time, discard them. Frozen foods are good for 4 hours after they begin to thaw. After that time, discard them.

If you have enough advance warning about a possible power outage, you can extend the storage time of food left in a freezer (at the time of emergency) by filling empty spaces with water to freeze. Fill clean plastic containers or jugs with water and freeze them. It will take 24-48 hours to freeze. Food will keep in a well-insulated, well-filled, closed freezer for 2 to 3 days (Van, 2011) After that time, the thawed water can be used to drink.

Consider the following things when selecting emergency food supplies.

- Avoid foods that will make you thirsty. Choose salt-free crackers, whole grain cereals, and canned foods with high liquid content. You can also choose high calorie, non-thirst provoking foods such as peanut butter, jelly, food bars, and trail mix (FEMA, 2004).
- MREs (Meals ready to eat) designed for the military, are the easiest meals you can put in your kit. They have an incredibly long shelf life (up to 10 years when stored at temperatures below 70 degrees F). You can buy complete meals that include entree, side dish, dessert, drink mix, and utensils all in a pack. Or, you can stock up on individual entrees, side dishes, and desserts separately. These meals are designed to be heated, but can be eaten cold since they are already fully cooked (Korn, 2009).
- Stock ready-to-eat canned meats, fruits and vegetables, and instant soup.
- Include foods for infants, elderly persons, or persons on special diets (for example, diabetics or those with allergies).
- Be sure to include some favorite foods and snacks in your emergency food supply, specifically for raising spirits.

MAINTAINING YOUR 3-DAY EMERGENCY FOOD STORAGE

Just as important as putting your supplies together is maintaining them so they are safe to use when needed. Here are some tips to keep your supplies ready and in good condition (FEMA, 2004):

- Keep the foods in a cool, dry place.
- Store paper-boxed foods in tightly closed plastic or metal containers to protect them from pests and to extend shelf life.
- Throw out any canned goods that become swollen, dented, or corroded.
- Use foods before expiration dates and replace them with fresh supplies, or change stored food and water supplies every 6 to12 months.
- Re-evaluate your food and water storage needs annually.

EMERGENCY WATER

IN THIS SECTION

EMERGENCY WATER STORAGE

INTRODUCTION

Our abundant domestic water supply is generally of little concern. However, situations might occur when the supply of safe water is interrupted due to earthquakes or flooding. Interruptions could be for only short periods of time, or in the case of natural disasters, the supply could be cut off for days. Gunlock, Utah, experienced 7 days of isolation without power, cell-phone service, or water, as the flood of 2005 washed out access to the rest of Washington County.

Ed Bowler lives in Gunlock and St. George, his son Kip, with his wife Lisa, live in Gunlock. Prior to the flood, Ed had commented to Kip, "What on earth are you doing with four 50-gallon drums of water?" Kip replied, "That's my wife Lisa's food storage program." "Isn't that a touch of overkill?" Ed commented. After the 7 days of isolation, Ed went to Lisa with hat in hand, and said "I am so grateful you had four 50-gallon drums of water for us to use when we were out of water for 7 days" (Henderson, 2005).

With the potential for flooding due to high snow pack in many Utah counties, it is recommended that citizens evaluate their emergency water supply in the event that water lines are temporarily washed out.

AMOUNT OF WATER FOR STORAGE

The Department of Defense, Office of Civil Defense, states that a quart of water or other fluid a day will sustain life, but humans would be much more comfortable, especially in warm weather, with one gallon per day. Recommendations for the amount of water to be stored vary from ½ gallon to one gallon per day per person, for food preparation and drinking

purposes only. An additional ½ to one gallon per day is recommended for personal hygiene and dishwashing. Only a short-term supply of water can be stored in most homes. Storing at least a three-day supply is recommended, or up to two weeks if you have adequate storage space.

CONTAINERS FOR WATER STORAGE

Many types of containers are available for water storage. Containers should be "food grade," meaning they were meant to hold food or water. The most commonly used containers are glass, plastic, and metal. The best containers have secure lids and a spout or spigot that allows for dispensing water with minimal or no contamination (Miner, 2005).

Glass: Glass provides a fairly effective container for storage and is non-permeable to vapors and gases. Glass should not be the sole means of water storage since it is easily broken and may be damaged during an emergency.

Plastic: Plastic bottles or jugs previously used for beverages make excellent containers. They are lightweight and fairly sturdy. Food-grade plastic containers are sold commercially for water storage and can be purchased at many stores.

Non-food-grade plastic containers are not recommended for food storage because harmful chemicals can leach into the food. Very lightweight plastic might split or degrade under storage. Most plastics used in waterbeds or pool liners are not approved food storage plastics.

Metal: Stainless steel can successfully be used for water storage. Other metals are not optimal containers unless they are coated and made specifically to hold food or water. Pewter or lead-soldered metals should be avoided.

CLEANING AND SANITIZING WATER CONTAINERS

Water containers should be cleaned with warm, soapy water and rinsed. Special attention should be given to containers that previously contained food or beverages. Fill container with potable tap water, and then add 1 tablespoon bleach for each 1 gallon of water. Shake well, turning bottle upside down a time or two to sanitize the cap. Let stand for 1 minute, and then pour out the bleach water. Let the container air dry.

TREATMENT FOR STORED WATER

Tap water or well water is not sterile. The few microorganisms present can multiply during storage and have the potential to cause illness. Water that is to be stored for long periods of time should be treated to control microbial growth. Be sure to use the best quality water possible for storage.

Heat Treatment: One effective way to store water is in clean canning jars. Fill clean Mason-type quart or half-gallon jars with water, leaving 1 inch of headspace at the top of the jars. Attach two-piece metal canning lids. Fill a boiling water canner half full of water and preheat the water to approximately 140° F. Place jars into the water bath. Add more boiling water if necessary so that jars are covered by 1 inch of water. When water returns to a rolling boil, process jars for 20 minutes. Remove jars from the canner and allow them to cool. After seals set, remove screw bands and place jars in storage. Canned water often will have a white mineral precipitate or ring at the water level. This is normal.

Chlorine Treatment: Liquid chlorine bleach (unscented) can be used to disinfect water for long-term storage. Use fresh chlorine bleach since it can lose up to half its strength after 6 months. One gallon of water can be treated by the addition of 1/8 teaspoon of liquid chlorine bleach containing 4 to 6 percent sodium hypochlorite. (Most bleach contains 5.25 percent.) This is equivalent to 8 drops of liquid chlorine bleach. During storage, the bleach will break down into oxygen and table salt (U.S. Environmental Protection Agency, 1993).

BOTTLED WATER

Bottled water can be a quick and convenient way to store water. Although it is convenient, it is not considered to be any safer than tap water. Standards for public water supplies are set by the Environmental Protection Agency and those for bottled water are set by the U.S. Food and Drug Administration. Additionally, the International Bottled Water Association (IBWA) works with the industry to assure that FDA regulations are followed, assuring a safe,
high-quality product.

WHERE TO STORE WATER

Store water in a clean, dry place off the ground and away from sunlight. Since plastic is permeable to certain vapors, water stored in plastic should not be near gasoline, kerosene, pesticides, or similar substances. If you have freezer space, store water in the freezer. It not only acts as water storage but if the electricity goes out, it will help keep foods frozen. Leave 2 to 3 inches of headspace in container to allow for expansion as the water freezes.

When potable (drinkable) water is properly disinfected and stored, it should have an indefinite shelf life. To maintain optimum quality, water should be checked every 6 to 12 months. Check for secure lids, broken or cracked containers, and for cloudiness. Replace the water and treat as before.

EMERGENCY SOURCES OF WATER

In an emergency, if you have not previously stored enough water, you can use the potable water from pipes, your hot water

heater, water softener reservoir, and ice cubes. Be sure and turn off the heat source first when removing water from a hot water heater. Unless you are advised that the public water supply has been contaminated and is not safe, open the drain valve at the bottom of the water heater and salvage the water stored in the heater and any that may drain back through the pipes. Once water has been drained into clean, sanitized containers, add 8 drops of chlorine bleach per gallon of water, and stir or shake the solution to mix it. Let it set 30 minutes before use.

It is advised to only use the water from your toilet tank, waterbed, or swimming pool as a last resort, since these sources may have chemicals present making them un-drinkable. Treat these sources of water as non-potable. Never use water from the toilet bowl. Other sources of non-potable water are river or lake water. Filter murky or cloudy water through a clean cloth or allow the sediment to settle before disinfecting it as described below.

EMERGENCY SOURCES OF WATER

Some emergency situations could occur where the only water available is contaminated by disease-causing organisms. In this case, the same procedures can be used for treatment as follow:

Heat Treatment: Boiling is the preferred method. This heat treatment requires water to be boiled in a vigorous rolling boil for 5 minutes for any altitude in Utah. Taste may be improved by pouring the boiled water back and forth from one clean container to another several times to incorporate air.

Chemical and Filtration Treatments: Chemical treatment is less desirable than heat treatment because the effectiveness depends on several variables such as: (1) the amount of organic matter in the water, (2) water temperature, and (3) the length of time after the chemical is added until the water is used. Furthermore, chlorine or water purification tablets will not kill parasite cysts such as Giardia and Cryptosporidium. It is recommended to both filter and chemically treat non-potable sources of water to minimize potential contamination from bacteria, viruses, and parasites (FEMA, 2005).

Chlorine Treatment: Clear water can be treated with ¼ teaspoon (16 drops) of liquid chlorine bleach per gallon. Use fresh bleach. Mix the water and allow it to stand for 30 minutes before using. If water is cloudy in appearance, chemical treatment is not recommended. A slight chlorine odor should be detectable in the water. If not, repeat the treatment and let stand an additional 15 minutes before using.

Water Purification Tablets: Different types of tablets are available for water purification purposes. Be sure to follow the manufacturer's directions for treatment and allow sufficient time for the chemical to work before using the water. Check the label for expiration date since the tablets can become ineffective with time. Most tablets have a storage life of 2 to 5 years unopened.

Commercial Water Filtration Units: You can filter water if you have a commercial or backpack filter that filters to 1 micron. These are available in sporting good stores and are recommended for use when backpacking. They are not recommended to filter large volumes of water or for water with a lot of sediment. Filtering at 1 micron eliminates bacteria and parasites such as Giardia and Cryptosporidium, but it may not eliminate viruses. Therefore, it's recommended that 5 to 7 drops (1/8 teaspoon) of chlorine bleach be added per gallon of filtered water. Wait 30 minutes before using the water, or cap the containers and store them in a cool, dry place.

CONTAMINATION BY RADIOACTIVITY AND CHEMICALS

No effective method for decontamination of water that contains radioactive or chemical fallout is available for home use. This decontamination should be supervised by local or state health officers.

WATER PURIFICATION METHODS

INTRODUCTION

Purification, also known as disinfection, is the process of removing organic and inorganic chemicals and particles from water to improve color, taste, and smell. This process does not guarantee microbiologic safety because it may not remove enough microorganisms, leaving a small risk of infection even after purification. The best solution is to use a variety of methods to ensure safety (Backer, 2002).

Before purifying, water should be filtered with a water filter, paper towels, a coffee filter, or a clean cloth to remove particles (Miner, 2013).

TYPES

There are many ways to purify water: boiling, chemical treatments, UV light, distillation, etc.

BOILING WATER

Rapidly boiling water for 1 minute is the safest and most effective way to kill all bacteria, disease-causing organisms, and giardia cysts by forcing organic chemicals out of the water (Curtis, 1998) but will not remove other contaminants such as heavy metals, salts, and most other chemicals (Miner, 2013). At altitudes above 6,562 feet (>2000 m) the Centers for Disease Control and Prevention (CDC) recommends boiling water for 3 minutes; at higher altitudes, water boils at a lower temperature (Backer, 2010). After boiling, let the water sit and cool to room temperature in its container (Clark, 2013). Do not add ice to quicken the cooling process (CDC, 2013).

Advantages: Boiling is an easy way to disinfect water because electric or gas ranges, camp stoves, wood fires, or microwave ovens all can be used.

Disadvantages: Boiled water can have a stale taste, it requires high temperatures, it is time consuming, fuel sources may be unavailable, a limited amount can be boiled at one time, and it doesn't prevent recontamination during storage (UNL Water, 2013).

Adding a pinch of salt to each quart, pouring water back and forth between containers to incorporate oxygen (this does present the risk of recontamination from handling), and adding flavors to the water, such as lemonade mix, will help to improve the taste (Curtis, 1998).

CHEMICAL TREATMENTS

The most common chemical treatments consist of the halogens chlorine and iodine. There are a variety of different versions of these chemical treatments, so it is important to carefully follow the directions for each treatment. It is also important to pay attention to expiration dates and when the bottle/package was opened because the treatments become ineffective with time (Backer, 2010).

Effectiveness: The temperature, pH, and clarity of the water determine the effectiveness of the purification process. The colder the water, the more difficult it is for chlorine and iodine to purify it. If the water temperature is below 40° F, the treatment time should be doubled before drinking. The ideal temperature for treating water chemically is 60° F. Water temperature can be raised by placing it in the sun before treating (Curtis, 1998).

Filtering before purifying water increases the effectiveness of the treatment because the particles in the water may neutralize the disinfectant. If filtering is not a possibility and the water is cloudy, higher dosage amounts of the chemical or lengthened contact times are required for effective purification (follow directions on package). Make sure that the containers holding the water being treated are also disinfected splashed (Curtis, 1998).

After the chemical is added and dissolved, it will take about 30 minutes for the water to purify (Curtis, 1998). Lengthening the contact time increases safety (Backer, 2010).

Disadvantages: The use of chemical treatments alters the taste of water. However, taste can be improved with the same methods used to improve the taste of boiled water. If adding flavor to the water such as lemonade mixes, it should be added after the chemical treatment process. A tiny pinch of ascorbic acid can also be added to water after the chemical treatment process to improve taste. Reducing the concentration, increasing contact time, and using a filter that contains activated carbon after treatment can also improve the taste (Backer, 2010).

Another disadvantage is that some waterborne parasites, like cryptosporidium, are harder for halogens to disinfect, even with lengthened contact time. Thus, chemical disinfection should be coupled with different sources of purification as well (Backer, 2010).

CHLORINE

Chlorine treatment is effective in the disinfection of viruses, bacteria, and parasites, but may not be effective in disinfecting cryptosporidium oocytes (Backer, 2010). Chlorine treatment is a safe way to purify water for those people who have iodine allergies or restrictions. Users should follow the manufacturer's instructions for proper use (Curtis, 1998). Chlorine treatment is more effective with higher temperatures and lower pH (more acid) (Curtis, 1998).

Advantages: Chlorine is a residual disinfectant that prevents bacterial regrowth and protects against the invasion of viruses, bacteria, parasites, etc. Chlorine is readily available at a low cost. It can be used to treat many water problems such as bacteria, iron, manganese and hydrogen sulfide. It can also be used to disinfect large amounts of water (Mancl, 2010).

Disadvantages: Disinfection with chlorine takes about 30 minutes and it may not be as effective in cloudy water. It causes the water to taste like chlorine, and it may combine with precursors to form trihalomethanes (THMs). Low levels of chlorine are not as effective in killing cryptosporidium oocytes (Mancl, 2010). THMs are disinfection by-products that are formed when chlorine interacts with organic materials found in water. Health effects from low doses of THM are unknown (Mancl, 2013).

HOUSEHOLD LIQUID BLEACH

When using bleach to disinfect water, only regular household liquid bleach should be used with 5.25 percent sodium hypochlorite. This is the primary disinfectant promoted by the CDC and World Health Organization (WHO). Scented, color safe or added cleaner bleach should NOT be used (Backer, 2010).

For each gallon of water, add 16 drops of bleach from a sterilized medicine dropper, stir, and let sit for 30 minutes. The water should have a slight bleach smell; if it does not, repeat the dosage and let sit for another 15 minutes (Andress and Harrison, 2013).

Amount of Water to be Treated	Drops of Bleach
1 quart or liter	4 drops
2 quarts, 2 liters or half gallon	8 drops
4 liters, 1 gallon	16 drops

Drops of Bleach	Measuring Units
8 drops	1/8 teaspoon
16 drops	1/4 teaspoon
32 drops	1/2 teaspon
64 drops	1 teaspon
192 drops	1 tablespoon
384 drops	1/8 cup (2 tablespoons)

CHLORINE DIOXIDE

Chlorine dioxide (ClO_2) is similar to chlorine in that it is capable of disinfecting bacteria, viruses, protozoa, and parasites; however, ClO_2 is also capable of treating cryptospordium, enteroviruses, E. coli, and amoebas (Solsona and Mendez, 2003).

Compared to chlorine, ClO_2 is shown to form less disinfection by-products (DBPs) like THMs and haloacetic acids. However, ClO_2 does form chlorite and chlorate. The U.S. Environmental Protection Agency maximum contaminant level for chlorite is 1.0 mg/liter but the WHO has not set a guideline yet for the amount of ClO_2 to be used for the treatment of water. However, a temporary guideline for chlorite is 200 mg/liter to avoid toxicity (Solson and Mendez, 2003).

ClO_2 uses oxidation to disinfect which improves the taste, smell, and color of the water and also contributes to less THM formations (Solsona and Mendez, 2003). ClO_2 also has an effective residual (Apel, 1993).

IODINE

Storage: Iodine should be stored in a dark bottle because it is sensitive to light (Curtis, 1998).

Advantages: Iodine is more stable than chlorine in the presence of organic and nitrogenous compounds contributing to a better residual, and iodine may be better at disinfecting giardia cysts than chlorine (Goodyer and Behrens, 2006).

Disadvantages: Iodine treatment may have adverse effects on health which are not yet determined. It affects the color of the water (straw-like color), causes water to taste like iodine, and doesn't kill algae (Mancl, 2013). Water temperature determines the amount of iodine to be used.

Caution should be taken when using iodine for disinfecting water. WHO recommends limiting the use of iodine for treatment of water to only a few weeks of emergency use because it affects physiologic activity of the body. Individuals should not use iodine for treatment of water if they have thyroid disease that is not under control, if they have an iodine allergy, or if they are pregnant (Acosta, 2013).

Types of iodine:

Crystalline Iodine: Crystalline iodine may be used to disinfect water. However, crystalline iodine is poisonous and may be fatal if 4-8 grams (single dose) is swallowed. Follow the directions when working with crystalline iodine to avoid hazard (CDP, 2013).

A crystalline iodine solution is made first and then added to water to be disinfected. The colder the water, the longer the standing time should be.

a. At temperatures of 68-77° F, let the water sit for 20 minutes after adding the solution.
b. Every 10 degrees less than 77° F, the sitting time of water should be doubled before drinking (CDP, 2013).

Liquid 2 percent Tincture of Iodine: Add 5 drops per quart when the water is clear. Add 10 drops per quart when the water is cloudy or add 12 drops where giardia cysts may be present (Goodyer and Behrens, 2006). One gallon of water requires 20 drops of iodine for clear water (20 drops = 1 ml); 40 drops for cloudy water (Mancl, 2013). After adding iodine, let the water sit for 30 minutes before drinking. The colder the water, the longer the standing time (for each 10 degrees less than 77 F, the water should stand for double the time before drinking it (CDP, 2013).

Iodine Tablets: Follow instructions provided by manufacturer. The number of tablets should be doubled if the water is cloudy. Increase the standing time of extremely cold water (less than 41° F). Make sure that the right tablet size is used for the amount of water to be treated (CDP, 2013).

POTASSIUM PERMANGANATE

Potassium permanganate has been used in the past to disinfect

water. It may be effective in treating cholera vibrio but is not effective in treating other disease organisms. Potassium permanganate is not recommended for disinfecting water (Clark, 2013).

DISTILLATION

Distillation is a process where water is boiled and the vapor that condenses back to water is collected. Through the distillation process, microbes, heavy metals, salt, most chemicals, and radioactive fallout (radioactive dust and dirt) are removed, making the water safe to drink (Miner, 2013). A clean pot should be used that has a lid with a knob handle in the center.

Steps (Miner, 2013):

1. Fill pot halfway with water.
2. Turn the lid upside down and tie a cup under the handle. The cup should be hanging right side up (make sure it is not touching the water in the pot).
3. Boil the water for 20 minutes.
4. The cup will fill with distilled water.

Advantages: Distillation will remove microbes that resist other purification methods, such as heavy metals, salts, and most other chemicals (Miner, 2013).

UV LIGHT

Methods of water purification that use ultra violet (UV) light, like the steri-pen, are useful in killing small microorganisms like bacteria and viruses with low doses; larger protozoa like giardia and cryptosporidium require higher UV doses for disinfection (EPA, 1999).

Effectiveness of the UV light depends on the clarity of water, the UV dosage, and exposure time (EPA, 1999).

The UV sleeves should be cleaned often because buildup on the surface can decrease the intensity and disinfection capabilities of the UV light (EPA, 1999).

Advantages: UV lights are small, fast in treating organisms and meet EPA standards (Oldham, Crawford, Nichols, 2008). Using UV light does not alter the flavor or smell of the water (Mancl, 2013).

Disadvantages: UV light does not provide a disinfection residual like the chemical treatments (Acosta, 2011). Cloudy, colored water with particles hinder the effectiveness of UV light; therefore, water should be filtered before using UV light. The device must be cleaned and the lamp replaced every year (cleaning solutions are available for rinsing the unit to remove any films on the light source). UV light can be expensive (Mancl, 2013).

In general, UV light as a method of water disinfection is approved; but when it comes to specific devices, there is a lack of independent testing data (Backer, 2010).

COAGULATION-FLOCCULATION

Coagulation may be used as a pretreatment to the purification of water. The process of coagulation involves adding a chemical that causes elements to bond together. Flocculation is a process that forms larger particles by gentle mixing. Aluminum sulfate, lime, ferrous sulfate, etc., can be used as coagulants. If coagulation chemicals are not available, baking powder and fine white ash can be used in emergencies as coagulants (Ericsson, Steffen, Backer, 2002).

Directions: Add ⅛ teaspoon of coagulant per 1 gallon of water. Stir or shake the water vigorously for 1 minute. Then stir the water gently and often for at least 5 minutes to promote flocculation. If the water is still cloudy, add more coagulant and repeat mixing. Allow water to settle for 30 minutes and then pour through a cloth or paper filter. This process may remove between 40 percent and 99 percent of bacteria, but final steps of filtration and halogenation should be completed to ensure that disinfection has been achieved due to poor removal of viruses (Skipton, Dvorak, Albrecht, 2013).

Storage of Treated Water: Store treated water in a cool, dry place away from sunlight in clean containers, avoid dipping anything into the water, and keep the containers protected to prevent insects, dust, and other substances from getting into the water (Clark, 2013). Water can be stored for a long period of time but is the best quality if used within 6 months. Water in opened containers should be used within 1 or 2 days (Skipton, Dvorak, Albrecht, 2013).

WATER FILTRATION

INTRODUCTION

Water filters are used to remove microorganisms. There are some filters that have a chemical disinfectant matrix that are effective against some viruses; however, filters are not always effective in removing viruses. A combination of filtration and purification of contaminated water are recommended to ensure water safety (CDC, 2009).

Filters usually have a hand pump that draws water into the filter, and they work by pumping water through an intake hose or by slow gravity flow and through a microscopic filter that strains out harmful microorganisms. There are different sizes of filters depending on what organism is to be filtered out (Backer, 2011).

Most portable water filters are made of ceramic material, fiber or compressed granulated activated carbon (GAC); all of these materials create irregular and complex passages to catch organisms. Depth filters have a large capacity for holding particles, so they don't clog as fast as single-layer membrane filters do. When a filter is clogged, the water pressure increases and forces water through the filter with the risk of possibly forcing microorganisms through it and back into the water.

Most portable filters have a prefilter on the intake tubing to protect the main filter. If the filter does not come with a prefilter, a fine mesh cloth or coffee filter may be used instead. Flow can be improved in a clogged filter by back-flushing or cleaning the surface of a ceramic filter to remove large particles trapped close to the surface (Backer, 2002).

Advantages: Water filters are easy to operate, require no holding time for treatment, may improve the taste and appearance of water, and remove all microorganisms with the combination of chemical disinfections (Dvorak et al., 2009).

MICROORGANISM SIZE AND FILTRATION (Backer, 2011)

Organism	Average Size (Micrometer)	Maximum Recommended Filter Rating (Micromet Absolute)1
Viruses	0.03	Not Specified (Optimally 0.01)
Enteric Bacteria (E. coli)	0.5 X 3.0 - 8.0	0.2 - 0.4
Cryptosporidium oocyst	4.0 - 6.0	1
Giardia cyst	6.0 - 10.0 X 8.0 - 15.0	3.0 - 5.0

Disadvantages: Water filters may not be solely reliable in removing viruses, are bulky and add weight to baggage, will eventually become clogged, and they require cleaning or replacement (Dvorak et al., 2009).

REVERSE OSMOSIS

Reverse osmosis units reverse the flow of water with osmosis, forcing water to pass from a more concentrated solution to a more diluted solution through a semi-permeable membrane. A reverse osmosis unit has a pore size of about 0.0001 and is very effective in removing protozoa, bacteria, viruses, common chemical contaminants, and desalinating water. Because reverse osmosis units are expensive and have a slow output, they are mostly recommended as survival aids for ocean voyagers (Backer, 2002).

Advantages: Effective in removing viruses and the taste of chlorine and iodine (Dvorak et al., 2009).

Disadvantages: Filters can be pricey and time consuming with the use of hand pump filters (Dvorak et al., 2009).

COAGULATION- FLOCCULATION (CF)

This process removes particles that won't settle by gravity, particles that taste badly, and particles that make water cloudy. CF is capable of removing many but not all microorganisms. Coagulants such as aluminum sulfate, lime, ferrous sulfate, etc., are added, stirred well, allowed to settle, and then poured through a coffee filter to remove particles (Backer, 2002).

NSF INTERNATIONAL

NSF International is a nonprofit, nongovernmental organization that tests water filters and develops standards and product certification for public health and safety. They work in partnership with the World Health Organization (WHO) for Food and Water Safety and Indoor Environment. They are qualified by the American National Standards Institute (ANSI), the International Accreditation Service (IAS), and the Standards Council of Canada (SCC) for third-party certification (Backer, 2002).

Because NSF testing is expensive and voluntary, some filters may be effective but have not been NSF tested. Units that are not NSF certified but are more likely to be effective are those that contain reverse osmosis or have an absolute pore size of 1 micron or smaller (Backer, 2010).

OTHER INFORMATION

(Backer, 2011) (CDC, 2009)

- Membranes in some filters can be damaged by chlorine in the water. Always follow manufacturer's instructions for use, care and replacement.
- Filters that take a significant impact should be thrown away - filters that are cracked inside pose a risk of contaminated water flowing through the crack.
- The intake hose should be treated as if it is contaminated because it is submerged in unfiltered water and it should also be stored seperately from the filter.

FOOD STORAGE BASICS

IN THIS SECTION

SAFETY VS. QUALITY

INTRODUCTION

There are two issues to consider when storing foods: food safety and food quality, according to Brian Nummer, Utah State University Extension food safety specialist.

FOOD SAFETY

Foodborne illness can come from three sources: physical, chemical, and biological. The biological hazards include all of the microorganisms that cause foodborne disease, including botulism. Chemical hazards include non-food grade containers, cleaners, and pesticides. Physical hazards include things like stones or rocks.

MICROBIOLOGICAL HAZARDS

Store only dried foods or properly canned foods. Microorganisms cannot grow without water, therefore dried foods cannot support their growth. It is important to package dried foods so they cannot reabsorb moisture from the air or environment throughout their storage. Commercially canned foods are heat treated to destroy all pathogenic microorganisms and most spoilage microorganisms. Commercially canned foods will remain safe (despite any indicated shelf life) providing the can is completely intact. Any signs of can damage or food stains may indicate a can is compromised. Commercially canned foods stored in a very warm place may spoil due to the bacteria that only grow at these temperatures. Keeping commercially canned foods at ambient temperatures will prevent bacteria growth.

FOOD QUALITY

Foods naturally deteriorate as they age. The science of food storage and preservation has evolved from our attempts to slow that deterioration. The prime concern with shelf life quality of foods is preventing spoilage microorganisms from growing. This is done through food preservation methods (drying, canning, etc.). Oxygen is the next factor. Oxygen catalyzes chemical reactions that lead to rancidity. Rancidity oxidation occurs in fresh, frozen, and dried foods. Removing oxygen in most cases will extend the quality shelf life of foods.

FOOD QUALITY AND EMERGENCY FOOD STORAGE

Keep in mind that most commercially processed foods have a "best if used by" shelf life. This is the date that the manufacturer feels retains the intended quality of their food product. This is especially true for canned and dried foods, since neither of these foods supports microbial growth leading to spoilage or illness. Hence, their product shelf life is

determined by quality and not safety. The true shelf life of any safe (dried or canned) emergency food storage item is the time frame you are willing to use that food in an emergency. Even poor quality foods have nearly all of their original nutritional levels. It may taste bad, but may save your life in an emergency.

In contrast to "best if used by" dates is "use by" dates. "Use by" dates are usually food safety issues and should not be exceeded. Foods with "use by" expiration dates should not be used for food storage. Most people are not aware that expiration dates are not required by law. Consequently, there is little oversight of these dates. Some food storage manufacturers list expiration dates of 10, 20, and even 30 years on their products. These dates are rarely scientifically determined and are more of a marketing claim.

NUTRITION DETERIORATION

INTRODUCTION

The human diet must provide enough calories to meet daily energy needs, together with carbohydrates, essential amino acids, essential fats, minerals and vitamins for proper metabolism. During short-term emergencies you should be focused on food as a fuel. Don't worry about nutrition. For emergencies longer than 3 weeks, complete nutrition plays a more important role.

CALORIES

Calories are the measurement of energy stored in foods. The human body uses food as its fuel. Active adult females consume 2,400 calories per day, while inactive females consume approximately 1,800 calories per day. Active males can consume as many as 3,000 calories per day and 2,400 if inactive. Older adults and teenagers will consume 200-300 fewer calories than younger adults. Most average this requirement to be 2,000 calories per person, per day as minimum. In the absence of food, the body uses its reserve fuel (glycogen). Glycogen is stored as fat in the body. When fat reserves are low or gone, the body will begin to destroy and consume its own protein (muscle).

CARBOHYDRATES

Carbohydrates are carbon-containing compounds such as sugars and simple starches. These are termed simple carbohydrates. More complex forms exist and are part of the structure of grains, beans, and vegetables. Humans can consume these carbohydrates and use them as fuel and as building blocks for substrates the body needs.

ESSENTIAL AMINO ACIDS

Amino acids are the building blocks of protein. When plant or animal protein is consumed, it is broken down into amino acids. These can then be used in human metabolism. An absence of one or more essential amino acids over a period of weeks to months can lead to malnourishment symptoms of apathy, diarrhea, inactivity, failure to grow, flaky skin, fatty liver, and edema of the belly and legs. Excess amino acids can also be used as fuel for the body (calories).

ESSENTIAL FATS

Three key fatty acids are needed in the diet: linoleic acid, linolenic acid, and arachidonic acid. These are found in grain, vegetable, or nut oils.

MINERALS

Only small levels of minerals are needed for proper nutrition. These minerals are scavenged from many sources and it is rare for anyone consuming a regular diet to have a deficiency. In the overall scheme of nutrition, minerals should be of the least worry.

VITAMINS

Vitamins serve as metabolic assistants in many vital bodily functions. Vitamins A, B (1,2,3,12), C, D, E, K, and folic acid are required. Deficiencies lead to specific diseases such as beriberi and rickets. During short-term emergencies it is not necessary to worry about vitamin content of foods. It usually takes several weeks to months of deficiency before any symptoms appear. After an emergency, vitamin deficiency symptoms can rapidly disappear after consuming nutritious foods or supplements.

EFFECT OF STORING FOODS ON NUTRITIONAL CONTENT

Foods are complex mixtures of chemicals. During storage over time, these chemicals can break down or change. For the most part, the body can still use carbohydrates, amino acids, fats, and minerals that have been chemically changed during storage (Park, 1987). This means food storage, no matter how old, no matter how bad it tastes, will still provide fuel (calories) and nutrition. Vitamins are the only nutrient group that can break down to an unusable state. Therefore, during 3 week or longer emergencies, vitamin deficiency is increasingly important.

VITAMIN DETERIORATION

Oxygen, moisture, high temperature, prolonged cooking and storage time, pH, and light can affect the nutritional content of foods. Control of these factors helps to retain vitamin content of foods. Storage and cooking can be the cause for the loss of up to half of nutrients in food (Bastin, 2000).

Vitamin C (Ascorbic acid) is the most unstable. Almost immediately after harvest, vitamin C decreases rapidly in foods. It also decreases during storage, drying, and heating (Morris et al., 2004).

Vitamin B_1 (Thiamine) is damaged by high temperatures and in neutral and alkaline conditions, such as baking soda and baking powder. Vitamin B_1 also leaches out into cooking water (Morris et al., 2004).

Vitamin B_2 (Riboflavin) is sensitive to light at neutral and alkaline conditions (baking soda and baking powder). It is somewhat heat stable when in neutral conditions and sensitive to heat when under alkaline conditions (Morris et al., 2004).

Vitamin B_3 is one of the most stable vitamins, but it also leaches into cooking water (Morris et al., 2004).

Folate levels decrease with prolonged storage and heat and is lost in cooking water (Morris et al., 2004).

Vitamin B_6 is heat stable in alkaline as well as acidic conditions (Morris et al., 2004).

Vitamin B_{12} is destroyed by light and high pH levels (Morris et al., 2004).

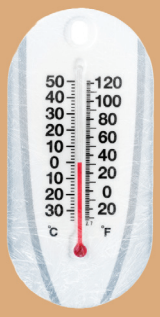
Vitamin A is easily destroyed by heat and is oxidized easily (Morris et al., 2004).

Vitamin D is easily oxidized by heat and light (Morris et al., 2004).

Vitamin E is also easily oxidized (Morris et al., 2004).

SUMMARY

Nutrient loss during food storage is limited to vitamins. Other nutrition will remain including carbohydrates, essential amino acids, essential fats, and minerals. Older stored foods should not be discarded for fear of nutrition loss. Instead, keep these items until they are replaced (NDSU, 1998). An old (safe) commercially canned food with all vitamins deteriorated has more nutrition than nothing at all. To compensate for vitamin loss during long-term emergencies, consider storing multi-vitamins or some sort of fresh food to meet vitamin needs. One may sprout wheat looking for vitamins. Wheat grass tastes and is equally as nutritious as Kentucky blue, burmuda, or zoysia grass (CSU, 2011).



STORAGE CONDITIONS

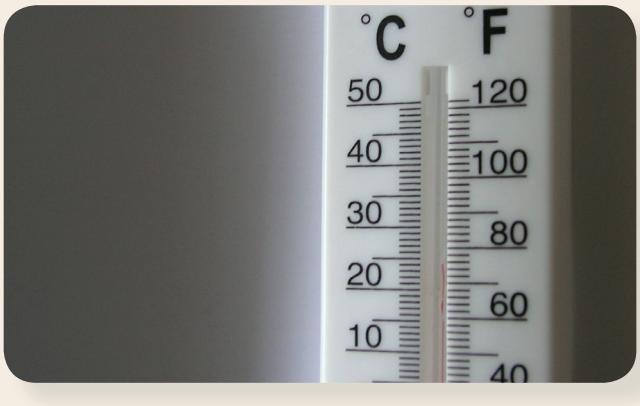
INTRODUCTION

Moisture and *temperature* are the two critical factors in optimal food storage.

Moisture: The humidity in the storage environment should be low. If dried foods pick up moisture from the storage area, mold, yeast, and bacteria can grow. This can lead to spoilage and potentially to illness. Moisture can also lead to the breakdown of some packaging materials (paper degradation and metal rusting). In areas of high environmental humidity, a dehumidifier may be needed.

Temperature: The optimal temperature is in the cool to moderate range, approximately 40 to 70° F. Research at Brigham Young University (Green et al., 2005) on long-term storage has shown that wheat retained an acceptable quality for 25 years when stored cool (basement) and only 5 years when stored hot (garage or attic). Grain germination rates will decline, and vitamin breakdown rates in all stored foods will increase as the temperature increases.

Canned foods should not be allowed to freeze. Freezing will bulge cans and may cause seam failures, leading to a potential for foodborne illness. Dry foods and honey can freeze without



concern. Oils can freeze and get cloudy. This is natural. They will become translucent again when they warm up.

Other Factors: Direct sunlight is detrimental to foods. It can speed deterioration of both the food and the packaging. The heat from sunlight can also speed deterioration. Always store foods off the floor. Flooring materials, especially raw concrete, can leech chemicals into stored foods. These chemicals can pass through plastics and can cause rust to form on metal.

WHAT NOT TO STORE

INTRODUCTION

Extension agents often receive questions about uncertain food storage recommendations. Some of these recommendations can be quite dangerous and should be carefully considered by the consumer, according to Brian Nummer, Utah State University Extension food safety specialist.

HOME CANNED BUTTER

The methods circulating for canning butter have not been scientifically determined, especially for unsalted, canned butter. It is true that there is one known manufacturer of canned salted butter, but we are unaware of any research supporting a safe canning process. Canning unsalted butter may be especially dangerous. Unsalted canned butter has NO protection from botulism.

PETROLEUM JELLY OR MINERAL OIL COVERED RAW EGGS

This is a shelf life extension (quality extension) method, NOT a food preservation method. There is a major foodborne illness risk if eggs are stored above refrigeration temperature. The rationale for this recommendation may come from the egg industry itself with one key fact left out. Mineral oil (often called egg oil) may be rubbed onto egg shells to fill their pores. This minimizes air and bacteria entry, prolonging their (refrigerated) shelf life. Many commercial eggs are treated in this manner today. But, the big difference is that they are always refrigerated. Some of the recommendations have been for room temperature storage.

VACUUM SEALED "WET" FOODS

Vacuum sealed dry foods are safe because of the absence of moisture. Vacuum sealing moist or wet foods provides the optimal environment for growth of botulism. Some people mistakenly see foods like tuna in a Mylar®-style pouch and assume it is only vacuum sealed. It is not. It is heat processed just as if it were in a can or Mason jar.

MILLED GRAINS

(Whole wheat flour, cornmeal, cereal, granola)

Basically, milling or grinding makes the interior surfaces of grains accessible to oxygen. The oxygen then can catalyze oxidation reactions leading to rancidity of the grain oils and causing changes to other chemicals in the flours. Consuming these foods in an emergency is safe, just not palatable.

OILY GRAINS OR SEEDS

(Nuts, brown rice, pearled barley, sesame seeds, and flax seeds)

Storing can cause quality deterioration. Oily grains or seeds are varieties that have high levels of oils subject to rapid rancidity. Rancidity is the oxidation of oils or fats producing volatile

aldehydes and ketones that smell and taste bad. Rancid foods are difficult for humans to consume, even under emergency situations. The more unsaturated the oil, the greater the chances for rapid rancidity. So, the better an oil is for you, the more likely it will deteriorate quickly. Consuming these foods in an emergency is safe, just not palatable.

HOME CANNED QUICK BREADS

This is unsafe and potentially dangerous. A recipe for baking zucchini bread in a canning jar has been widely distributed with a 45-minute baking time at 325 degrees F. The baking of the bread does not kill Clostridium botulinum. Clostridium is a spore-forming organism. The spores are resistant to destruction by heat or other environmental factors. Researchers at Kansas State University baked banana nut bread batter in canning jars at three different temperatures (350, 375 and 400° F) from 30 to 55 minutes. The batter had been inoculated with Clostridium spores. After baking and cooling, spores could be easily recovered after several days, weeks, and months. A person might then ask, how is regular bread safe from botulism? There are two reasons. The first is fermentation. Yeast consumes all of the available sugars and produces by-products that make it hard for the botulism organism to grow. Secondly, baking (outside of a jar) allows moisture loss, leaving breads dryer. Baking breads in jars traps in all of the moisture, perhaps leading to its popularity.

PACKAGING

INTRODUCTION

Moisture and oxygen are two of the most important factors in spoilage or deterioration of stored foods. Moisture in dried foods can lead to microbial growth. Moisture around metal canned foods could lead to rust and an eventual compromise of the can. Oxygen is an important factor in quality deterioration of many foods. To store foods over a prolonged period requires packaging that resists moisture and oxygen transfer. Foil pouches or bags, glass canning jars, plastic PETE bottles, and plastic buckets are common acceptable storage containers.

FOIL POUCHES

Polyethylene terephthalate (PET or PETE) and foil laminate pouches are exceptional food containers. The polyethyene (PET) layer is food-grade plastic with no known toxicities (Castle, 1989). The foil layer dramatically reduces the transmission of oxygen and moisture through the film. One trade name is Mylar®and it is often used as a generic name. Be aware that even though there is a metallic layer in the bag, rodents can easily chew into it. These bags come in many different sizes including one that fills a 5-gallon bucket (approx. 18”x28”). The 1-gallon bag holds approximately 7 pounds (3.2 kg) of wheat, 6.8 pounds (3.1 kg) of white rice, or 5 pounds (2.3 kg) of dry milk. Bags should be sealed using a heat sealing unit after first using oxygen absorbers to minimize oxygen. Sealing with an iron is not recommended due to a poor seal. Vacuum sealers may work for a few food types; however, powders and some granular products are not easily vacuum packaged. Remember, vacuum sealing is only safe for dry foods. Vacuum sealing moist foods may lead to botulism food poisoning.

GLASS CANNING JARS WITH SCREW-ON LIDS

All glass jars used to can foods work well for storing dry foods as well, provided a tight sealing lid is used. However, only Mason-type canning jars with two-piece lids can be used safely for home canning foods. Be sure jars are thoroughly cleaned of all previous food residue before using them for food storage. Mason jars with metal lids are an excellent barrier to oxygen and can be used for long-term storage.

Mylar®-type PET bag

Glass canning jar

PET bottle

Metal cans

PLASTIC (PETE) BOTTLES

PETE is the same plastic as in foil pouches but molded to form rigid bottles. The bottles are identified on the bottom, next to the recycle emblem, with the letters PET or PETE. This type of container has acceptable short-term (1-2 years) oxygen barrier qualities and can be used with oxygen absorbers to store bulk dry foods. The low oxygen content of the sealed containers protects the stored food from insect infestation and helps preserve product quality. These containers are well suited for products that are rotated on a regular basis, while still providing a few years of storage capability. Use only PETE bottles that have been previously commercially packaged with food. Bottles need to have screw-on lids with plastic, not paper or foam, lid seals (Matthews, 2000). Verify that the lid seal will not leak air by placing a sealed empty bottle under water and pressing on it. Wash and rinse bottles to remove any residue. Drain and dry bottles. Place an oxygen absorber packet into each bottle. Fill bottles with bulk dry products that are low in moisture and oil content. Wipe top sealing edge clean. Screw lids on tightly. Tape the lid edge to prevent loosening.

METAL CANS

Metal cans will have a near zero oxygen transfer rate and are great for very long-term storage (30 years). Packing foods in metal cans for storage is the most expensive method if done at home. The cans are relatively inexpensive, but they cannot be reused. The cans MUST be made for foods and lined with food-grade enamel. Number 10 cans are the most common. The weight varies by product. For example, a No. 10 can holds 5.8 pounds (2.6 kg) of wheat, 5.7 pounds (2.6 kg) of white rice, or 4.1 pounds (2.3 kg) of nonfat, instant dry milk (Hagan, 2013).

FOOD GRADE PLASTIC BUCKETS

Another common and easy-to-use container is a food grade plastic bucket with lid. These are made of high-density polyethylene (HDPE). HDPE will have a slow oxygen transfer rate that can allow oxygen in over several years. A general rule of thumb is that these buckets will store foods for up to 5 years. The 5 to 6 gallon size is common and useful for larger quantities of foods. Lids should have a sealing gasket to form an airtight seal. Some lids can only be used once and may disfigure after opening. A reusable lid has been created called gamma seal (Levy, 2012). These are available from specialty stores. The bucket wrench is an important tool for use in opening the gamma lids.

IMPORTANT NOTES

Convenience and price aside, the best container choice for long-term storage is the foil-type pouch (bag). Vacuum package or seal dried foods inside with oxygen absorbers. Place these bags inside a 5-gallon bucket or similar container that is a barrier to rodents. The second best is metal cans, although they can rust over time. Be sure any packaging choice is food grade. When in doubt, assume it is not food grade. Food grade plastics are tested so that they do not leach chemicals into foods during normal use. If reusing containers, do not reuse those that contained non-food items. Be aware that only metal is impervious. All plastics will allow some gas and chemical transfer, although slowly. Therefore, store all containers off the floor. It is possible that volatile compounds from flooring or raw concrete can slowly permeate containers.

HDPE bucket

Bucket Wrench

Gamma lid

The following chart may serve as a helpful guide to determining quantities in food storage.

Food Item	No. 10 Can	Cups in a No. 10 Can
Wheat	5 pounds	17.7 cups
White Flour	4.5 pounds	15.75 cups
Cornmeal	4.3 pounds	17.2 cups
Popcorn	5 pounds	12 cups
Rolled Oats	2.5 pounds	13.5 cups
White Rice	5.3 pounds	12.5 cups
Spaghetti	4.5 pounds	
Macaroni	3.1 pounds	14 cups
Dried Beans	5.6 pounds	11.2 cups
Lima Beans	5.4 pounds	10.8 cups
Soy Beans	5 pounds	10 cups
Split Peas	5 pounds	10 cups
Lentils	5.5 pounds	11 cups
White Sugar	5.7 pounds	12.8 cups
Brown Sugar	4.42 pounds	10 cups
Powdered Milk	3 pounds	12.5 cups
Powdered Eggs	2.6 pounds	
Apple Slices	1.25 pounds	10 cups
Potato Pearls	3.4 pounds	12 cups

CANNED FOOD, FAT, & OIL STORAGE

IN THIS SECTION

CANNED GOODS

INTRODUCTION

The steamboat Bertrand sunk to the bottom of the Missouri river in 1865. It was found a century later in 1968 under 30 feet of silt near Omaha, Nebraska. Among its provisions were canned foods including brandied peaches, oysters, plum tomatoes, honey, and mixed vegetables. In 1974, the National Food Processors Association (NFPA) analyzed the canned foods for bacterial contamination and nutrient value. Although the food had lost its fresh smell and appearance, the NFPA chemists detected no microbial growth and determined that the foods were as safe to eat as they had been when canned more than 100 years earlier (Atkins, 2010).

For the purpose of this section, "canned foods" refer to foods canned in liquid. Canned dried foods are not included. Canned foods are safe alternatives to fresh and frozen foods and help meet dietary needs. Commercially canned foods can make up a large portion of any emergency food supply. Proper storage can greatly increase the shelf life and quality of canned foods.

QUALITY & PURCHASE

Canned foods can either be purchased commercially or home canned. Home canned foods should be canned using research-tested recipes and processes like those found in the USDA Complete Guide to Canning (USDFA, 2009) or in Extension publications. Use only the best quality foods to can at home. Home canning processes can never improve the quality of foods. Commercially canned foods are superior to home canned for food storage. Commercial canners can closely control quality and safety to produce the best product. Commercially canned foods for storage can be purchased at

grocery stores and similar outlets. Avoid budget resellers (e.g., scratch and dent sales, dollar stores, etc.). Purchase canned foods in either cans or jars. Avoid rusted, dented, scratched, or bulging cans.

PACKAGING

Foods are commercially canned in glass jars with lids, metal cans, or special metal Mylar®-type pouches. All of these materials are suitable for food storage. Home canners should only can in Mason-style canning jars with two-piece metal lids as recommended by the USDA Complete Guide to Canning. Home canning in metal cans or metal Mylar®-type pouches requires special knowledge and equipment. Improper processing of home canned foods could lead to Clostridium botulinum food poisoning.

STORAGE CONDITIONS & SHELF LIFE

Carefully label all home canned or commercially canned food containers. We recommend labeling purchase date (month and year) on can lid with marker. Store all canned food in a cool, dark, dry space away from furnaces, pipes, and places where temperatures change like un-insulated attics. Do not

allow sealed cans or glass jars to freeze. Freezing changes food textures and leads to rust, bursting cans, and broken seals that may let in harmful bacteria (Long and Crapo, 2004). Always store metal cans off the floor, especially bare concrete. Moisture can wick up to cans and encourage rusting.

As a general rule, unopened home canned foods have a shelf life of 1 year and should be used before 2 years. Commercially canned foods should retain their best quality until the expiration code date on the can. This date is usually 2 to 5 years from the manufacture date. High acid foods usually have a shorter shelf life than low acid foods. For emergency storage, commercially canned foods in metal cans or jars will remain safe to consume as long as the seal has not been broken. (That is not to say the quality will be retained for that long.) Foods "canned" in metal Mylar®-type pouches will also have a best-if-used by-date on them. The longest shelf life tested for this type of packaging has been 8 to 10 years (personal communication U.S. Military MREs). Storage for longer than 10 years is not recommended (Bingham et al., 2006).

NUTRITION

Canned foods maintain mineral content for their entire shelf life. Vitamins A & C will decrease rapidly after fruits and vegetables are picked and cooked. Vitamins are lost during heating processes. However, once canned, vitamin A and C loss slows to 5 to 20 percent per year. Other vitamins remain close to fresh food levels (OIUC, 1995). Salt or sugar is not necessary for safe canning and is only added for flavoring.

ALLERGIES: Be sure to label canned goods with ingredients when canning mixed foods like sauces to accommodate those with food allergies.

USE FROM STORAGE

Always use FIFO (first-in, first-out), meaning use your oldest cans first. Before opening, discard any badly dented, bulging, rusty, or leaky cans or jars that have broken seals. Open cans or jars to view and smell contents. When opening, discard any can that spurts. Discard contents (do not taste) if there is a strange odor or appearance.

If there is no strange appearance or odor, taste a sample. For added safety, in the case of older canned foods, you may wish to boil the food for 10 minutes before tasting. Discard if there is an off-flavor. High-acid foods may leach metal or metallic flavors from cans if food is left in open cans; move unused portions, to another container, cover and store in the refrigerator. Low-acid foods should be heated to 165° F or boiled for 5 to 10 minutes before eating. Once opened, canned foods may last between a day and a week, depending on the food.

CANNED FOOD APPEARANCE DEFECTS

Defect	Cause	Safe to Consume
Brown color or dark color	Oxidation or chemical breakdown of food pigments	Yes
Soft food texture	Chemical breakdown of plant or animal tissue	Yes
Crystal in canned fish	Magnesium ammonium phosphate crystals are naturally formed	Yes, crystals dissolve with heat
White crystal in some fruits like apricots or grape juice	The crystals are a natural acid-salt complex	Yes, if food has no off odors
Food above the liquid level in home-canned foods		Yes

MREs
(MEALS-READY-TO-EAT)

INTRODUCTION

MREs (meals-ready-to-eat) were developed to replace the old "c" and "k" rations for military personnel. They were released by the U.S. government as a food source for the military in 1975 (Alspach et al., 1998). MREs were designed as a self-contained, individual field ration in lightweight packaging. All MREs are ready-to-eat as is; no mixing, cooking, or water addition. Previous rations were either canned foods that were heavy to carry or dried foods that required rehydration. The major innovation in creating MREs was the tri-laminated metalicized heat-stable pouch. The plastic pouch is lightweight, heat-stable, and flexible.

QUALITY AND PURCHASE

Initially MREs were only produced for the military by subcontractors; therefore, obtaining a case or two meant getting them by dubious means. Due to the prevalence of unauthorized sales to civilians, the military began placing a notice on MREs stating that resale was not permitted. Because of the demand, there are two different types of MREs today; military and civilian. Many of the military subcontractors simply started making a consumer version of MREs for sale to the public. Often the package label looks very similar to the military version. MREs are widely available both in specialty stores and online. Specialty stores such as emergency preparedness, survival, and camping stores typically carry a variety (MREinfo, 2013).

The quality of MREs is similar to canned foods. They are safe to eat providing the metalicized pouch is not compromised.

PACKAGING

Polyethylene terephthalate (PET or PETE) and foil laminate pouches are exceptional food containers. The polyethylene (PET) layer is food-grade plastic with no known toxicities and makes up the innermost layer that touches foods. The foil layer is in the middle and dramatically reduces the transmission of oxygen, CO2, and moisture through the film. The outer layer is polyester, a tough but non-food grade plastic (ILSI, 2000). One trade name is Mylar®and is often used as a generic name. Be aware that even though there is a metallic layer in the bag, rodents can easily chew into it. As soon as the MRE package is opened, it is vulnerable to bacterial growth. Military MRE packaging requirements are strict. MREs must be able to withstand a parachute drop from 1,250 feet and non-parachute drops of almost 100 feet.

STORAGE CONDITIONS & SHELF LIFE

The military stores MREs in climate-controlled warehouses to prolong shelf life. The colder they are stored, the longer they last. MREs should not be frozen, or if they freeze they should be carefully handled because the foil layer can crack.

The shelf life of foods packaged in retort pouches depends on storage temperature. For military MRE's the food is required to maintain a minimum shelf life of 3½ years at 27° C (81° F), 9 months at 38° C (100° F), and short durations from −51° C (−60° F) to 49° C (120° F). The military has validated MRE safety for up to 10 years. Beyond that time is not recommended, simply because no data is available (MREinfo, 2013).

The following chart represents a general indication of the effects of storage temperature on the shelf life of MRE-type food products.

Temperature (Fahrenheit)	Storage Life in Months
100º	22
90º	55
85º	60
80º	76
75º	88
70º	100

NUTRITION

A typical military MRE contains between 1,200-1,300 calories. (Forester, 2007) The military designed their menus knowing that soldiers in the field should not eat more than 21 days straight of MREs. Most MREs offer complete nutrition, including vitamins. Typically, military MREs contain 39 percent carbohydrates, 15 percent protein, and 36 percent fat.

ALLERGIES: MREs procured for military use may or may not have an allergen statement on them. However, all commercial MREs made for direct sale to consumers are required to carry both ingredients and an allergen statement. Most will also have a nutrition facts panel.

USE FROM STORAGE

Tear open the packaging and enjoy.

FATS & OILS

INTRODUCTION

Edible fats and oils are not highly perishable foods because of their absence of water. Microorganisms require water to grow. Fats and oils have variable shelf lives during which minor changes occur. Fats are generally solid at room temperature and oils are liquid at room temperature. Fats and oils contain a glycerol backbone and three fatty acids that make up triglycerides. The number of carbon units in the backbone determines its length. The longer the fatty acid, the more likely the triglyceride is to be a fat; the shorter the fatty acid, the more likely the triglyceride is to be an oil.

QUALITY AND PURCHASE

Fats and oils are the raw materials for liquid oils (e.g. vegetable oil, olive oil), shortenings, margarines, and other specialty or tailored products that are functional ingredients in food products. They are commonly found in almost any grocery store, usually in plastic containers of different sizes. The quality of edible fat depends on three factors: the type of raw material employed; the storage time and temperature of the raw material before rendering, and the type of rendering equipment used. Do not home can butter for emergency storage.

Rancidity is a chemical reaction of fats and oils that produces off flavors and off odors. Fats and oils go rancid because of two chemical processes; hydrolytic rancidity and oxidative rancidity. Hydrolytic rancidity occurs when the fat (triglyceride) is broken up into free fatty acids and glycerol by the presence of water. The presence of the enzyme lipoprotein lipase (LPL) quickens this process. The unfavorable odor and flavor are the results of tasting individual short chain fatty

acids instead of the whole triglyceride. Dairy products are mostly affected by hydrolytic rancidity. Keeping fats and oils cold slows down the hydrolytic rancidity process, but even freezing does not stop the quality deterioration completely (McWilliams, 2006).

Oxidative rancidity occurs in fats and oils that contain unsaturated fatty acids; mostly because unsaturated fats are less stable than saturated fats. Oxidation produces an accumulation of aldehydes and ketones, which are compounds that are also responsible for the unfavorable flavors and odors. Heat, light, oxygen, and metal ions encourage (speed up) oxidative rancidity. To prevent oxidative rancidity, products should be kept cool and covered or sealed from air. Do not combine new and old fats (Klein, 2013).

PACKAGING

Solid fats are often sold in cans or plastic containers looking like cans. Oils are most often sold in plastic bottles. Oils are rarely sold in glass containers. Metal cans are the most resistant to long-term oxygen transfer (transmission of oxygen

through the material over time). Plastics are not that resistant to oxygen transfer and will allow significant oxygen levels into the container in 1 to 2 years.

STORAGE CONDITIONS & SHELF LIFE

All fat or oil foods deteriorate even when handled and stored under ideal conditions. Store oils away from oxygen (air) if possible. Storing oils below room temperature reduces the rate of oxidation and slows the development of rancid flavors. Freezing oils or fats will not cause the container to explode out. Fats and oils will actually contract a little when frozen.

Oils that do not require heating to remain liquid resist deterioration more than the higher melting products. Most shortening and other similar products will maintain an acceptable flavor and oxidative stability for 2 to 3 weeks in melted form with adequate controls (Shelf Life Advice, 2010).

NUTRITION

Lipids (fats and oils) perform many life-supporting functions in each cell of our body. They are part of every cell membrane and every organ and tissue. Fats add flavor to the foods that many of us are used to and savor and they also serve as a great energy source that provides 9 calories for every gram of fat consumed. A few vitamins only dissolve in lipids (Haas, 2006).

In a normal diet (non-emergency situation) there are healthier choices for fat intact. Polyunsaturated and monounsaturated fats are less likely to cause heart disease compared to saturated fat. Polyunsaturated and monounsaturated trans-fats also cause health concerns. However, during an emergency situation, long-term heart disease will take a back seat to immediate concerns for survival.

ALLERGIES: There are no known allergies associated with fats or oils. Some may think that soybean oil would be an allergen; however, commercially processed soybean vegetable oil contains no protein and therefore it is not allergenic.

USE FROM STORAGE

Fats and oils can be used as is directly from storage. Once a container is opened and contacts air, the shelf life will drop. Therefore, opened containers should be used relatively quickly. Rancid fats or oils cannot be made palatable. Few recipes could possibly add enough strong ingredients to distract the human palate. Simply discard rancid oils and replace them.

Type of Fat/Oil	Refrigerator	Freezer	Pantry
Butter, opened	2-3 weeks	--	--
Butter, unopened	1-2 months	9 months	1-3 months
Vegetable oil, opened	--	--	6 months
Vegetable oil, unopened	--	--	2 months
Salad oil, opened	--	--	3 months
Salad oil, unopened	--	--	--
Margarine, opened	1 month	--	--
Margarine, unopened	4-5 months	1 year	--
Peanut butter, opened	6 months	--	2-3 months
Peanut butter, unopened	--	--	6-9 months
Vegetable shortening	6-9 months	--	3 months
Olive oil*	--	--	1-2 weeks

*Olive oil can become rancid quickly at room temperature, but it develops fat crystals in the refrigerator. However, olive oil can be stored in the freezer and allowed to thaw.

DRIED FOOD STORAGE

IN THIS SECTION

FOOD STORAGE FACTORS FOR DRIED FOODS

INTRODUCTION

Storing food is a traditional domestic skill that has been used for thousands of years in times of plenty to prepare for times of famine or when food is in short supply. Wheat found stored in vessels in the tombs of Egypt was still edible after 4,000 years. For hundreds of years, food has been stored and eaten from harvest to harvest as families strive to be self-sustainable. It is interesting to note that food is stored by almost every human society and by many animals. Maintaining a food supply often ensures savings of time and money and provides safety and security in times of need. Food storage has several purposes:

- Preserves harvested and processed food products for later use
- Provides a balanced diet throughout the year
- Prepares for catastrophes, emergencies, and periods of food scarcity or famine
- Religious reasons
- Peace of mind
- Self-sustainability

Food quality is also a factor that will be affected by time and storage conditions. The quality of food is defined as color, taste, texture, and odor. Food colors will darken, the taste will intensify or decrease, the texture will soften, and the smell will change. Food quality will decrease with age, but proper storage can prolong shelf life.

FACTORS THAT AFFECT FOOD STORAGE

Temperature: The temperature at which food is stored is critical to the shelf life. Lower temperatures for stored foods generally increases shelf life. The United States Department of Agriculture (USDA) states that for every 10.8 degrees in temperature rise, the shelf life of stored food is decreased by half. The best range for food storage is a constant temperature between 40-60 degrees. Fluctuating temperatures can also cause food to deteriorate faster.

A BYU study (Pike, 2007) indicated that pinto beans did experience a slight loss of quality during storage. However, samples that had been stored up to 30 years had greater than 80 percent acceptance by a consumer taste panel for emergency food use. The study concluded that pinto beans should be considered acceptable for use in long-term food storage.

Moisture: The higher the moisture content of food, the shorter the shelf life of the product. Moisture allows bacteria and mold to grow. It is recommended that moisture be removed when storing foods.

Dehydrated and freeze-dried foods are best for long-term storage. Dehydrated foods should have a 10 percent or less moisture content.

Oxygen: Oxygen is a key element in the storage of foods. Oxygen can cause an oxidization process that creates a chemical change in the properties of stored foods. Foods store best when oxygen free. Removing oxygen will prevent oxidation of compounds in foods.

Ways to remove oxygen:

Displacing oxygen: Purge air from product with an inert gas (nitrogen). Dry ice is often used, which gives off carbon dioxide gas that displaces oxygen. When using dry ice, use caution and follow instructions. It will generally take 4 ounces of dry ice for a 5 gallon bucket to create the CO2 and push the air out of the container.

Oxygen absorber: Air contains about 78 percent nitrogen and 21 percent oxygen, leaving about 1 percent for the other gasses. If the oxygen is absorbed, what remains is 99 percent pure nitrogen in a partial vacuum. *Seeds store better in nitrogen. However, if using seeds for sprouting or as garden seed, store in oxygen.*

Light: Light is a form of energy and when shone on stored foods long enough, transfers energy to the food product. That energy then has the effect of degrading its nutritional content and appearance. Fat soluble vitamins, such as A, D, and E, fats and proteins are sensitive to light degradation. When opening a glass jar of food and finding the food inside two-toned, it was likely exposed to too much light. Although unappealing in flavor and color, it should still be safe to consume. **Store food in dark areas.**

Store foods in food-grade plastic, metal, or glass containers. Containers should not contain chemicals that could be transferred to food and harmful to health. If reusing previous food containers, particularly those that are plastic, be aware that plastic can absorb molecules and contains smells and flavors of its previous contents that can be transferred to currently stored foods. Opaque containers will reduce the amount of light reaching the food, thus protecting its quality, even food that is stored in a pantry. For best storage life, use containers with a hermetic (air tight) seal.

Containers with air tight seals are:

- No. 10 Cans
- Sealable food storage buckets
- Sealable food quality metal (lined) or plastic drums
- Foil pouches

The containers listed above, used with oxygen absorber packets, eliminate food-borne insects and help preserve nutritional quality and taste.

Warning - Botulism poisoning can occur if moist products are stored in packaging that reduces oxygen. When storing foods in airtight containers with oxygen absorbers, products must be dry (about 10 percent or less moisture content).

Infestation: Several common insects infest home-stored dried foods. If infestations are prolonged, foods may be seriously damaged and may need to be discarded. These so called pantry pests typically pose little health hazard, although some species (carpet beetles), can produce irritation or allergic reactions. To control with cold treatment, put infested items in a deep freezer (0 degrees) for 3 to 4 days, which will kill any live insects, larva and eggs.

Shelf date: This is the "best if used by" date meaning that you are getting most of the original taste and nutrition. The "life sustaining shelf life" date means the length of time that food is still edible. "Sell by" means the store should sell the product by the printed date, but the product still can be safely eaten by the consumer. "Best if used by" means the consumer should use the product by the date listed for best quality and flavor (not for safety reasons). "Use by" or "expires" means the product should be used by consumers by the date listed; you are likely to see a marked deterioration in product quality and spoilage after that date.

DRIED BEANS

INTRODUCTION

Legume (bean) varieties such as: Adzuki, Black, Black-eyed, Black Turtle, Garbanzo, Great Northern, Kidney, Lentils, Lima, Mung, Navy, Pink, Pinto, Small Red, Soy, and Split-pea can all be dried and stored. These dried beans have been used as a staple in diets dating back long before Biblical days. Dry beans are dense in nutrition and have been shown to reduce disease and encourage good health. Most Americans should consume about 3 cups of beans per week (Raatz, 2010).

Beans come in various flavors, colors, shapes, and sizes but the nutritional content is similar. Beans are full of protein, carbohydrates, and are low in fat. Beans are rich in vitamins and minerals, which may reduce heart disease and cancer.

QUALITY & PURCHASE

For the most part, dry beans are graded U.S. No.1 (best) through U.S. No. 3, based on defects. Lesser quality beans are generally graded "substandard" or "sample."

PACKAGING

Like most stored foods, beans are best stored in the absence of oxygen and light. Oxygen can lead to rancidity of bean oils and light will quickly fade bean color. The packaging choices are No. 10 cans or Mylar®-type bags. Canning jars are suitable for smaller quantities provided the jars are stored in a dark place. Oxygen absorbers should be used to remove oxygen from the packages to extend shelf life and minimize off-flavors.

STORAGE CONDITIONS & SHELF LIFE

Dry beans should be stored in airtight containers in cool, dark, dry conditions. For best color and flavor, use dried beans within 12 months. Storing beans in temperatures within 50-70 degrees and in moisture-free areas will lengthen their shelf life. Research indicates that beans are an ideal long-term (20-30 years) food storage product when stored in No. 10 cans, Mylar®-type bags, or airtight containers and in ideal cool, dry, and dark conditions. Beans purchased in normal polyethylene (food-grade) bags generally have a shelf life of 1 year or more. A research study conducted by Brigham Young University indicated that pinto beans did experience a slight loss of quality during storage. However, samples that had been stored up to 30 years had greater than 80 percent acceptance by a consumer taste panel for emergency food use. The study concluded that pinto beans should be considered acceptable for use in long-term food storage (IFT Annual Meeting, 2005).

NUTRITION

Dry beans average about 22 percent protein in the seed, the highest protein content of any seed crop. They contain many essential amino acids. Beans are an excellent source of fiber, starch, minerals, and vitamins. Some beans do have a human digestion enzyme inhibitor. This enzyme can cause a nutritional deficiency if the beans are eaten raw. Cooking destroys the enzyme. Most beans naturally contain cyanogens. These are sugars with a cyanide component attached (C-N). The Environmental Protection Agency (EPA) allows levels of cyanide in dried beans up to 25 ppm. Small amounts can be handled by the human liver and are not toxic. Cooking will also help break down and remove the cyanide. Toxicity levels are hard to reach. It would require a person eating approximately 1 pound of beans for each pound of their weight at one sitting (Vetter, 2000).

USE FROM STORAGE

All dried beans, except lentils and split peas, require soaking in water for rehydration. Typically, 3 cups of water is needed for every 1 cup of dried beans. Allow beans to soak overnight and then rinse them in clean water. To cook beans, cover rehydrated beans with water in a stock pot. Simmer for 2-4 hours until beans are tender. Once tender they can be spiced and used in cooking recipes. As dried beans age, the seeds become harder. This results in longer rehydration and cooking times. At some point, the beans will no longer rehydrate and in that case must be ground as bean flour. Adding 1 teaspoon of baking soda will also help soften beans during soaking time (Decker, 2011).

DRIED MILK

INTRODUCTION

Dry milk products (powdered milk) are an excellent nutritional staple in a well-planned food storage program. The most common option for dry milk products is non-fat dried milk (NFDM), and is suitable for both short and long-term emergency food storage. It is made from non-fat, grade A milk that has been dried by spraying into hot air or heated on a drum. This process removes nearly all of the water prohibiting the growth of microorganisms.

QUALITY & PURCHASE

Dry milk products come in two main forms: regular (non-instant) and instant.

Regular: Regular non-fat dry milk has not gone through the extra process and takes a little more effort to stir in and dissolve when added to water. It typically works best to reconstitute in warmer water, then chill, after it is completely dissolved.

Instant: Is simply non-fat dry milk that has gone through an extra process where the milk has more air put into the granule and puffs it up so when it gets added to water (of any temperature), is will quickly dissolve and reconstitute. Instant NFDM is usually more expensive than regular NFDM. There are no significant differences in the nutritional value of these two NFDM forms.

There are also "dry milk alternatives" available. These products are made with the whey, or soy, or a combination of both. They will be listed as a "milk alternative", and are fortified, like milk, with vitamin A and D. They reconstitute easily and quickly taste like milk.

Dried whole milk, and dried buttermilk, have milk fat and are not as suitable for long-term storage because they will go rancid more quickly. They are available, but are a little more difficult to find.

Evaluate several brands of dried milk before purchasing any large quantity for emergency storage. A recent study concluded there is wide variation in the quality of flavor acceptability of dried milk products available for long-term storage. (Lloyd and Pike, 2002)

PACKAGING

Dried milk must be stored free of moisture, light, and oxygen. Mylar®-type bags and No. 10 cans make good containers for large quantities. Canning jars are suitable for smaller quantities provided light is prevented from reaching the dried milk. Other plastic containers are less suitable, e.g., food-grade buckets. Oxygen absorbers should be used to remove

oxygen from containers to extend shelf life and minimize off flavors. A USU study (Driscoll, Brennand, Hendricks, 1985) concluded that after 4 years, NFDM samples stored in plastic bags (not Mylar®-type) were statistically less acceptable than samples stored in cans. The form of milk (instant or regular) did not affect the length of time NFDM could be stored. Unacceptability of samples in the study was due to an oxidized/stale flavor.

Another study conducted at BYU also determined that the comparison of instant and regular NFDM showed no significant differences in storage, indicating both types were suitable for storage. Though there is some decline in quality and nutrition over time, it appears possible to retain palatability and nutritional value in NFDM during long-term storage by using adequate packaging and storage conditions. Manufacturers need to ensure proper packaging of their products to optimize shelf life. (Lloyd, 2003)

STORAGE CONDITIONS & SHELF LIFE

The main factor in shelf life of nonfat dried milk is storage temperatures. At cool to cold temperatures, the shelf life is 3 to 5 years for optimum color, flaor, and nutrient retention. At hot temperatures, the shelf life can be as little as 3 months. A USU research study (Driscoll, Brennand, Hendricks, 1985) demonstrated NFDM held at 32°C (90°F) for 6 months began to develop off -flavors and by 24 months was considered unacceptable by a trained sensory panel. After 4 years, NFDM samples stored at 21°C (70°F) were rated unacceptable by the panelists. Storage at 10°C (50°F) resulted in minimal flavor changes in 52 months. After reconstituting dry milk with water, refrigeration in a covered container is necessary to maintain freshness and quality. The shelf life of packaged NFDM ranges from 3 months to 3 to 5 years. Because NFDM has no fat or moisture, it remains shelf stable for long periods of time. The cooler the storage conditions, the longer the shelf life, especially when packaged in low oxygen and airtight containers.

NONFAT DRY MILK, 1 CUP (68G)

Energy	243 kcal
Carbohydrates	35 g
Sodium	373 mg
Fat	0.0 g
Protein	24 g
Cholesterol	12 mg
Dietary Fiber	0.0 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/**

NUTRITION

NFDM is an excellent source of protein, calcium, and nutrition, providing 80 calories per serving. Most vitamins in dried milks are present in comparable levels to those of whole milk. Vitamins A and D are not present in non-fat milk and must be supplemented. Individuals with lactose intolerance may have difficulties with NFDM.

USE FROM STORAGE

Typically 1/3 cup dry powder is mixed with 1 cup water to make 1 serving. The instant NFDM will dissolve in water more readily. Non-instant, or regular non-fat dry milk versions may need blending or can be held overnight in the refrigerator after reconstituting to increase solubility. Reconstituted NFDM will not taste any better than fresh non-fat milk. If the absence of milk fat is objectionable, mix reconstituted NFDM into whole fresh milk. NFDM can be used to make or replace a variety of dairy-based items, such as coffee creamer, basic sauces, puddings, and yogurt. NFDM can also be used in recipes calling for milk by combining dry milk with dry ingredients, then adding amount of water equal to the amount called for in the recipe. Once opened, NFDM will have a 3-month shelf life. Keep opened containers stored in cool, dark, and dry conditions.

DRIED FRUITS

INTRODUCTION

One of the oldest forms of food preservation is drying. Drying foods at home to supplement a food storage program is a form of food preservation that is easy to do, as well as safe (if done properly). It is also an option to purchase commercially prepared dried fruit, and it is most often freeze dried, although it is possible to purchase commercially dehydrated fruits as well. Any one of these "dried" fruit choices provides a food that is sweet and full of flavor. Freeze dried fruits, while sweet, bright, and full of flavor, are also the most expensive option of the dried fruit choices available.

The drying of fruit is a tradition that has found a permanent place in today's market. The following sections will give more information regarding storage and nutrition.

QUALITY & PURCHASE

A wide variety of dried fruit is available at local grocery stores, as well as through food storage distributors, depending on the quantity, form of drying, and type of packaging you are interested in purchasing. Most commercial food storage distributors will sell their products in No. 10 cans with an oxygen absorber.

Note: It is generally not a good idea to store the fruit that you personally dried for long term. While it is possible to get it dry enough, many have trouble with mold.

PACKAGING

Most dried fruit comes in packages that are re-sealable or in single serving boxes. The most common are apples, dried

apricots, raisins, craisins, and prunes. When possible, it is best to keep the fruit in the original package. If that becomes a problem, transferring the fruit to another airtight container is perfectly acceptable.

Recent studies at Brigham Young University indicated a wide variation in head space oxygen levels and can seam quality of dehydrated apple slices packaged for long-term storage and available for sale at the retail level. Manufacturers need to ensure proper packaging to optimize product quality during extended storage (Oesterle, Ogden & Pike, 2003).

STORAGE CONDITIONS & SHELF LIFE

Dried foods are susceptible to insect contamination and moisture re-absorption and must be properly packaged and stored immediately. Dried fruits prepared in No. 10 cans typically have a much longer shelf life. Some manufacturers report a 25-year shelf life.

When storing home dried fruits, the following guidelines from the National Center for Home Food Preservation will be helpful:

First, cool completely. Warm food causes sweating which could provide enough moisture for mold to grow. Pack foods into clean, dry insect-proof containers as tightly as possible without crushing.

Second, store dried foods in clean, dry home canning jars, plastic freezer containers with tight-fitting lids, or in plastic freezer bags. Vacuum packaging is also a good option.

Third, pack foods in amounts that can be used all at once. Each time a package is re-opened, the food is exposed to air and moisture that can lower the quality of the food and result in spoilage. Also, pack food in amounts that will be used in a recipe.

Fourth, fruit that has been sulfured should not touch metal. Place the fruit in a plastic bag before storing it in a metal can. Sulfur fumes will react with the metal and cause color changes in the fruit.

Fifth, dried foods should be stored in cool, dry, dark areas. Recommended storage times for dried foods range from 4 months to 1 year. Because food quality is affected by heat, the storage temperature helps determine the length of storage; the higher the temperature, the shorter the storage time. Most dried fruits can be stored for 1 year at 60° F andsix months at 80° F. Vegetables have about half the shelf life of fruits.

Sixth, foods that are packaged seemingly "bone dry" can spoil if moisture is reabsorbed during storage. Check dried foods frequently during storage to see if they are still dry. Glass containers are excellent for storage because any moisture that collects on the inside can be seen easily. Foods affected by moisture, but not spoiled, should be used immediately or re-dried and repackaged. Moldy foods should be discarded. (National Center for Home Food Preservation)
Note: *If you choose to store your own fruit, it might be helpful to obtain oxygen-absorbing packets to reduce chances of spoilage.*

NUTRITION

The dehydration process of fruit concentrates the nutrients. The nutritional content of dried fruits includes protein, carbohydrates (sugars), fiber, and little to no fat. One thing to keep in mind when it comes to dried fruit is that the sugars are concentrated in the food because the water has been depleted. A small serving of dried fruit can be relatively high in calories, thus, giving us instant energy. Dehydrated fruits are also a good source of vitamins A, B1, B6, and B12. Calcium, iron, magnesium, phosphorous, potassium, sodium, copper, and manganese are also found in dried fruit.

APPLES, DRIED 1 CUP (86G)

Energy	209 kcal
Carbohydrates	57 g
Sodium	75 mg
Fat	0.0 g
Protein	1 g
Cholesterol	0.0 mg
Dietary Fiber	7 g

RAISINS, 1 CUP (165G)

Energy	493kcal
Carbohydrates	131g
Sodium	18mg
Fat	1g
Protein	5g
Cholesterol	0.0mg
Dietary Fiber	6g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/**

ALLERGIES: If you are prone to nut allergies, check the label to make sure the fruit was not packaged in a location that also processes nuts.

USE FROM STORAGE

There are many ways that dried fruit can be used. Some include:

- An easy low-fat snack
- Add to your favorite cookie, muffin, or quick bread recipe
- Trail mix
- Create unique flavor combinations in salads
- Liven up cereal or oatmeal

DRIED VEGETABLES

INTRODUCTION

Dried vegetables have become a very popular addition to food storage programs. Dried vegetables can be found commercially in both the dehydrated form and in the freeze dried form. It is also a common food preservation practice to home dry vegetables in either the oven or a dehydrator. Each option has its advantages and disadvantages. One of the advantages to commercially freeze dried vegetables is the color and flavor retention, but the disadvantage is the cost. One advantage to the commercially dehydrated vegetable is the cost, but the disadvantage is the flavor over time.

There are a number of advantages to having dried vegetables in a food storage program. One advantage is the minimal amount of space required for storing because so much of the water content has been removed, the vegetables take up less space. Another advantage of dried vegetables is they do not require refrigeration/freezing, which lowers storage costs. There are many options to choose from in the dried vegetables available to consumers today.

QUALITY & PURCHASE

When adding dried vegetables to a food storage program, be sure to consider your plan for use and rotation in making decisions about the choices, variety, and options that will fit your specific needs and budget.

Freeze-dried vegetables are superior to other mechanical/home dried vegetables for storage. Freeze-drying uses low heat and causes little damage to the tissue, taste, or aroma. Products easily restore and closely resemble the taste, texture, and nutritional content of the original food. In sun drying

or in mechanical drying, the cell walls are often damaged and the essential flavor and texture of the food is lost during evaporation of water. The extent of loss depends on the type of drying method used and the expertise in controlling other drying parameters. Commercial dryers can closely control quality and safety to produce the best product. Commercially dried vegetables can be purchased at grocery stores and food storage outlets. Check the labels for freshness of the dried product at the time of buying.

Vegetables selected for drying should be sound, fresh, and in the peak of condition: ripe, but still firm and at the right state of maturity. Vegetables that are inferior before drying will be inferior after drying. Wilted or inferior material will not make a satisfactory product. Immature vegetables will be weak in color and flavor. Overly mature vegetables are usually tough, woody, and lack flavor. Over-mature and/or bruised products are likely to spoil before the drying process can be accomplished. Even when using an oven or an electric dehydrator, it will be necessary to watch out for the effects of humidity on drying foods.

PACKAGING

Dried foods should be sealed in airtight packages or containers to prevent them from picking up moisture from the air, thus causing them to mold or spoil. There are several options manufacturers use to package the dried food: plastic laminated foil pouches (like Mylar®™), metal and plastic cans, or heavy plastic bags. Most of these are then vacuumed packed to remove as much air as possible. Many may also have oxygen absorber packets added. Some may have a nitrogen gas pumped into the container to replace the oxygen and prevent oxidation and spoilage.

Home dried foods are susceptible to insect contamination and moisture absorption and must be properly packaged and stored immediately. First, cool and condition completely. Conditioning is an important safety measure because packaging warm food causes sweating, which could provide enough moisture for mold to grow. Pack foods into clean, dry, insect-proof containers as tightly as possible without crushing (Brennand, 1994). If possible, pack the foods in amounts that can be used after opening the package without requiring further repackaging and storage. Glass jars (preferably dark colored), metal cans, or boxes with tightly fitted lids or moisture- and vapor-resistant freezer cartons make good containers for storing dried foods. Heavy-duty plastic bags are acceptable but are not insect and rodent-proof (Schmutz and Hoyle, 1999). To protect from insects and re-absorption of moisture, seal lids onto containers. Wrap the edge where the lid meets the container with a plasticized, pressure-sensitive tape or a clean, 1-inch cloth strip dipped in melted paraffin. Bags may be heat-sealed or closed with twist ties, string or rubber bands. Label containers with the name of the product, date, and method of pretreatment and drying (Kendall et al., 2012). Oxygen absorbers can also be used to remove oxygen from the packages to extend shelf life and minimize off-flavors.

STORAGE CONDITIONS & SHELF LIFE

Containers of dried vegetables should be stored in a dry, cool, dark place away from furnaces. Low storage temperatures extend the shelf life of dried products. Always store metal cans off the floor, especially bare concrete. Moisture can wick up to cans and encourage rusting. If there is enough space, dried vegetables can also be stored in the freezer to enhance the shelf life. Foods that are packaged seemingly bone-dry can spoil if moisture is reabsorbed during storage. Check dried foods frequently during storage to see if they are still dry. Glass containers are excellent for storage because any moisture that collects on the inside can be seen easily. Foods affected by moisture, but not spoiled, should be used immediately or re-dried and repackaged. Moldy foods should be discarded (Schmutz and Hoyle, 1999).

Properly stored, dried vegetables keep well for 6 to 12 months. Discard all foods that develop off smells or flavors or show signs of mold. All dried vegetables deteriorate to some extent during storage, losing vitamins, flavor, color, and aroma. For this reason, dried vegetables will not retain their appeal indefinitely. Recommended storage time for dried foods range from 4 months to 1 year. Because food quality is affected by heat, the storage temperature helps determine the length of storage; the higher the temperature, the shorter the storage time. Vegetables have about half the shelf life of fruits and can generally be stored for 6 months at 60° F or 3 months at 80° F. (Schmutz, Hoyle, 1999). The sensory shelf life of dehydrated potato flakes packaged in no. 10 cans held at ambient temperatures was found to be 16 years (Neilson et al., 2006).

NUTRITION

Drying, like all methods of preservation, can result in loss of some nutrients. Nutritional changes that occur during drying include (Kendall et al., 2012):

- **Calorie content:** does not change, but is concentrated into a smaller mass as moisture is removed.
- **Fiber:** no change.
- **Vitamin A:** fairly well retained under controlled heat methods.
- **Vitamin C:** mostly destroyed during blanching and drying of vegetables.
- **Thiamin, riboflavin, niacin:** some loss during blanching but fairly good retention if the water used to rehydrate is also consumed.
- **Minerals:** some may be lost during rehydration if soaking water is not used. Iron is not destroyed by drying.

CARROTS, DEHYDRATED, 1 CUP (74G)

Energy	252 kcal
Carbohydrates	59 g
Sodium	204 mg
Fat	1 g
Protein	6 g
Cholesterol	0.0 mg
Dietary Fiber	17 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/**

Blanching vegetables to destroy enzymes before freezing and drying reduces the amount of heat-sensitive and soluble vitamins to some degree. There could be some nutrient loss if canned and dried food is stored at high temperatures (Rabb, 2007).

A research article in American Journal of Food Technology reported that ascorbic acid (Vitamin C) reduced to half in leafy vegetables as a result of drying, but storage for 12 weeks in polyethylene wrappers did not result in much further loss. Light destroys vitamins A and C content during storage. It can be prevented by use of a dark colored or opaque container. One typical change that occurs during storage of dehydrated vegetables is darkening or "Maillard Browning." This browning is a complex chemical reaction between the food's sugar and protein.

USE FROM STORAGE

There are many ways to use dried vegetables such as: soups, side dishes, and casseroles. Before using, check the contents of the container and discard any vegetables that have an off odor or show any signs of spoilage or mold.

One cup of dried vegetables reconstitutes to about 2 cups (Neilson et al., 2006). Most vegetables are soaked or rehydrated in cold water prior to use. Add sufficient water to keep them covered. After soaking, simmer until desired tenderness. There are two other acceptable rehydration methods: adding the dried product to hot/boiling water or adding the dried vegetable to a product with lots of liquid, such as soup. Whichever rehydration method is chosen, the vegetables return to their original shape. Vegetables can be soaked in either water or, for additional flavor, bouillon or vegetable juice. They usually rehydrate within 1 to 2 hours. If they are soaked for more than 2 hours, or overnight, they should be refrigerated. Using hot/boiling liquid speeds up the soaking process. Save and use the soaking liquid in cooking. Adding dried vegetables directly to soups and stews is the simplest way to rehydrate them. Leafy vegetables, cabbage, and tomatoes do not need to be soaked (Brennand, 1994).

DRIED MEATS

INTRODUCTION

Drying, smoking, and curing (salting) meat to preserve it for longer storage has been in practice for many hundreds of years. Drying, or dehydrating, can be done for the sole purpose of extending the meat for storage, but it is also one of the processing steps for the manufacturing of specific meat products, such as for prosciutto or salami. These meats are considered a "fermented" meat, and are not traditionally considered for most home food storage programs.

Dried meats generally fall under two main categories: fermented and non-fermented.

Fermented meats (also known as salted/cured meats) have been prepared with salts as rubs or marinades, as well as other spices for flavor, and combined with drying. In order for these meats to be safe for longer-term storage with or without refrigeration (depending on the meat), they need to have moisture reduced to between 15 percent-50 percent weight loss, depending on the meat product. In these products, drying and fermenting go hand in hand in order to reach a desired flavor and shelf life safely (Brennan, n.d.). This is a very controlled and specific environment with proper temperatures, time, and humidity controls established. Examples of fermented meats are salami (of all types, such as a pepperoni) and chorizo.

Non-fermented dried meats are another category. The production techniques used also allow meat to be held for safe keeping at non-refrigerated storage temperatures and food storage. These meats are most common and typical to a dry pack food storage program.

There are two ways for drying meat for food storage. One is freeze drying, and the other is dehydrating. Both methods are used commercially, but only dehydrating is readily available for home production of dried meats.

Freeze Drying: A process for preserving foods, including meats, actually started in World War II. It was discovered that freeze drying serums for the wounded soldiers kept the serums medically viable without refrigeration. This discovery, over time, evolved to freeze drying many other foods and has been vastly improved and used for many different purposes. Freeze drying involves flash freezing the cooked meat, then drawing off the water through a process called "sublimation."

Freeze dried meats are the most common form of commercially prepared meats for home food storage.

Dehydrated (or Drying): A process for drawing off moisture through the use of low heat (heat adequate to dry food out, but moderate enough not to cook the meat) and air flow. Meats can be prepared and preserved at home for food storage in this manner, and it is used commercially as well.

Home production of dried foods can be done both outdoors (sun or solar drying), or indoors (oven or dehydrator). Sun drying, and solar drying, are not recommended for home production of dried meats (National Center for Home Food Preservation, 2013).

Jerked (or jerky): Probably the most popular dried (dehydrated) meat is jerky. While it used primarily as a snack food today, it is also probably the most common method of drying meat at home for food storage.

Jerky can be made with most any type of meat and is prepared through curing in a salt solution or marinade, either as cut strips of meat or as a ground meat. It can either be prepared in the salt solution as a raw meat or can be cooked before drying.

QUALITY & PURCHASE

When purchasing dried meats, be sure to buy from reputable suppliers (those who sell commercially). After buying dried meat, be sure to follow the storage instructions on the package and don't eat after expiration date to ensure quality of the product. Because drying meat is a complex process involving a number of steps, it should be understood that drying meats at home does not make the meat safe for long-term storage, unless being stored in the freezer.

PACKAGING

Many different types of packaging are used for dried meats, but all must be air-tight and moisture proof. This may include plastic laminated foil pouches, metal and plastic cans/canisters, or metal and fiber drums for bulk packaging.

Some freeze-dried food is vacuum packed, and the air is evacuated from the container before sealing. Other food has an inert gas like nitrogen injected into the container before sealing to displace the oxygen in the air and prevent oxidation or spoiling (Brennan, n.d.).

Once cans or packages are opened, store the food not consumed in moisture proof, airtight containers.

STORAGE CONDITIONS AND SHELF LIFE

Commercially prepared freeze dried meats need to be stored in cool, dry conditions. Home produced dehydrated meats, such as jerky, should be stored in airtight containers in either the refrigerator or freezer for long-term storage (So Easy to Preserve, 2006).

The shelf life for dried meats varies greatly, depending on manufacturer and type of method used for production. Most freeze dried meats, commercially prepared, have a range from 10-25 years.

NUTRITION

The primary nutrient found in meat is the protein. Unless individual food storage contains canned meats, it can be a challenge to get a complete protein and all of the essential amino acids meat provides. Therefore, many people like to add dried meats to their food storage for the complete protein it adds. The protein content is quite stable in dried meats.

CURED, DRIED BEEF (JERKY) 5 PIECES

Energy	32 kcal
Carbohydrates	0.6 g
Sodium	586 mg
Fat	0.5 g
Protein	6.5 g
Cholesterol	11 mg
Dietary Fiber	0.0

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/**

USE FROM STORAGE

Dried meat can be eaten directly from the package, or put in with other foods. (It should be noted that when dried meats are added to other food and rehydrated, they should be refrigerated and eaten within 3 to 5 days.)

DRIED EGGS

INTRODUCTION

Eggs are an amazing food, and may be considered (in their dried form) as an addition to your food storage program. Because fresh eggs are so perishable, the popularity of the dried, or dehydrated, eggs has increased in demand in not only personal home food storage, but also in military rations, the food service industry, and emergency relief.

Eggs are not only a great source of many important nutrients, and an inexpensive source of protein in their fresh form, but they are a key ingredient in many baked goods. Egg brings many beneficial characteristics to our baked goods, such as leavening (as in cream puffs), binding, emulsifying, thickening, and coating. These wonderful properties are not destroyed in the drying process…something else that makes them so valuable in food storage.

Please note: *While eggs do bring these qualities to baking, it is possible to have a perfectly usable food storage plan without the addition of dried eggs. The cost per serving of dried eggs verses fresh eggs is usually two to three times the cost for equal amounts.*

QUALITY & PURCHASE

Dried eggs can be purchased from many emergency preparedness, camping, and food storage retailers. For best quality and safety, purchase only dried egg products that have been pasteurized and bare the USDA inspection mark.

In 1970 Congress passed the Egg Products Inspection Act which requires that all egg products distributed for consumption be pasteurized to destroy Salmonella. In the

past 40 years, there have been no recorded outbreaks of salmonellosis linked to pasteurized egg products, since the institution of mandatory pasteurization. This safety record is especially impressive considering the volume of eggs consumed in this country. Of the more than 76 billion eggs eaten annually, slightly more than 30 percent are in the form of egg products, further processed into either a liquid, frozen, or dried form (American Egg Board, n.d.).

Manufacturers need to adhere to good manufacturing practices and buyers should be aware of product variability between brands of dehydrated whole egg (Gnadt, 2003).

Dried eggs can be found in three main forms: Dried whole eggs; dried whites; and dried yolk. (See Use From Storage section.)

PACKAGING

Dried egg products should be in a container that has a tight, unopened seal. Most importantly, the packaging must prevent moisture and rodent/insect damage. Many suppliers package dried eggs in cans or well-sealed pouches, both of varying

sizes. It is important to remember that once the packaging has been opened, its shelf life decreases. Many retailers offer large cans that can be bought at bulk pricing. These may save money, but it is best not to purchase a can so large that it cannot be consumed within a reasonable amount of time once opened.

STORAGE CONDITIONS AND SHELF LIFE

Dried eggs need to be stored in clean, cool, and dry conditions. It is important to keep the food in as cool a temperature as possible, without freezing. A temperature range of 50° to 60°F is ideal, but probably not possible for most of our home storage conditions.

The shelf life for optimum quality and nutrition of dried eggs is 1 to 2 years, depending on storage temperature, and if left unopened. This is not the shelf life guidelines being promoted from the manufacturers. Until further research is completed, the indicators for quality and acceptability of dried eggs is not in favor of long-term storage (Broderick, 2005).

The recommendation of many manufacturers for dried eggs is to refrigerate after opening. Many people opt to NOT refrigerate the remaining portion after opening, and the remainder should be stored in air tight, cool, dry conditions. One option would be to re-package in a smaller air tight container with an oxygen absorber.

NUTRITION

Dried eggs maintain a fair amount of nutrients after drying, but as with all stored foods, the nutrient retention lowers the longer the food is stored.

Dried eggs are a good source of riboflavin, Vitamin B12, and phosphorus, and a very good source of protein and selenium.

ALLERGIES: Eggs are a common allergen, and dried eggs are no different than fresh eggs in regards to allergies. Individuals with albumen/protein intolerance, or any other egg allergies, will not be able to use dried egg products.

DRIED EGG, WHOLE 85G (1 CUP SIFTED POWDER)

Energy	505 kcal
Carbohydrates	4 g
Sodium	445 mg
Fat	35 g
Protein	40 g
Cholesterol	1458 mg
Dietary Fiber	0.0

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/**

USE FROM STORAGE

Even though dried egg products, by law, will have been pasteurized (American Egg Board, n.d.), it is still recommended that dried eggs be thoroughly cooked before consumption. Reaching a cooking temperature of 160 °F is recommended for all egg products. It is important to remember that water will be necessary to reconstitute dried eggs. Follow specific reconstitution instructions on the products labeling. Once reconstituted, dried eggs can replace fresh eggs in any recipe. Dried eggs are a great addition to homemade dry mixes, such as muffin mixes, cake mixes, and cookie mixes.

Dried, whole eggs (powdered whole egg solids): Dried egg powder can be added right to the other dry ingredients in a recipe and the liquid in the recipe adjusted according to the number of eggs, making this a very convenient approach to baking. They can also be added to water and reconstituted before baking, or as an egg dish, such as an omelet.

On average, 1 pound of powdered dried whole eggs when added to water and reconstituted, is the equivalent of about 4 pounds of fresh eggs. For most dry whole egg powders, the reconstitution ratio is around 2 tbsp dried whole egg powder to 4 tbsp water stirred together to equal one large egg.

Dried, whites (powdered egg whites): Powdered egg whites are a "no hassle" way to get egg whites without having to separate the yolk from the white, and they are already pasteurized. Many powdered egg white manufacturers add sodium lauryl sulfate (an emulsifier and stabilizer) to the eggs, in very small amounts, to make the egg white more stable when beating or whipping, making them even more advantageous to use. Also: 2 tsp sifted dry egg white powder + 2 tbsp warm water = 1 egg white.

Dried, yolks (powdered egg yolks): Because there are some recipes that require the egg yolk only, the dried yolk powder is an easy solution to separating the white from the yolk. The reconstitution of the egg powder will vary from manufacturer to manufacturer, but usually requires only a small amount of powder for a couple of teaspoons of water in order to make one yolk equivalent.

Once a package is opened, put the unused portion into a container that has a tight-fitting lid; cover the container and store it in the refrigerator or other cool, dry place. Unless kept tightly covered, dried egg takes up moisture from the air and may absorb flavors from other foods. If dried egg takes up moisture in storage, it becomes lumpy and will not mix readily with liquid (USDA, 1956).

GRAINS, LENTILS, & CORN STORAGE

IN THIS SECTION

WHEAT

INTRODUCTION

Wheat is the cornerstone of any emergency storage supply. Approximately 150 lbs will supply an adult for 1 year. A 3-week emergency supply is approximately 5 to 10 lbs per adult. Children under 8 years old would need half that amount. Wheat has been separated into several commercial classes based on color, hardness of the kernel, and growing season. The hard wheat classes are produced in areas that have dry-temperate climates. The kernels are usually small, red, and have a hard texture. The white wheat classes are usually produced in areas where winters are relatively mild and there is adequate moisture. White wheat kernels are more plump and larger than red wheat kernels and have a softer texture than hard wheat. Wheat kernels are also known as wheat "berries." Gluten is a wheat protein that gives flour the ability to retain gases produced by bread yeast to permit dough leavening. The hard red wheat varieties are high in gluten and make the best bread flour. Gluten will degrade during storage and lose half its raising power after several years. Gluten can be purchased and added to poor quality flour to produce better quality bread.

QUALITY & PURCHASE

Whole wheat berries can be purchased from a producer (farmer). These grains are almost always not cleaned and may have been bulk stored for many months. Grains may also be purchased from a processor. In this case they may have been cleaned and packaged. Do not purchase "seed" wheat for storage, since these products may have had toxic chemical treatments. Lastly, grains may be purchased, cleaned, and packaged from a retailer. Please call your county Extension Office for local outlets to purchase grains for storage.

WHEAT CHART

Variety	Protein	Best Use(s)
Hard red spring, hard red winter & hard white spring	11-15 percent	Bread flour (high gluten)
Soft red winter, soft white winter & soft white spring	9-12 percent	Pasta, cake, biscuit, cracker, and pastry flours (low gluten)

PACKAGING

Store wheat in moisture-proof, food-grade packaging, such as Mylar® type bags, polyethylene bags, plastic buckets, or No. 10 cans. Be aware that rodents can chew through plastic bags. Wheat stored in ~10 pound bags is easy to manipulate, facilitates rotation, allows easy inspection of the grain, and compartmentalizes the grain so contamination of one lot does not contaminate large quantities of stored grain. Several bags can be placed inside a 5-gallon plastic bucket. It is not necessary to store wheat in the absence of oxygen unless insects are present.

STORAGE CONDITIONS & SHELF LIFE

Storage at 40-60° F is optimal for most home-stored grains, but is usually impractical in most homes except during winter months. Freezing or sub-zero temperatures do not damage stored grains. Storage at temperatures above 60° F causes a more rapid decline in seed viability (ability to germinate) but only a slightly faster loss in food value. A moisture level over 12 percent encourages mold growth and chemical degradation of all grains (barley, corn, millets, oats, rice, rye, sorghum, triticale, and wheat). Moisture above 12 percent may allow grains to start to respire, causing chemical degradation. Moisture above 15 percent will allow molds to grow. When the moisture reaches 20 percent, some bacteria can start to grow. The result is spoiled grain unfit for use. Store containers off the floor, especially concrete floors. Concrete can wick moisture to stored containers very easily. Inspect grain often for insect activity. Treat for insects (see below) or discard affected lots.

Develop a program to utilize stored wheat on a regular basis. As stored wheat is used, replace it with containers of new wheat. Identify each container for variety and storage date. A good rule of thumb is to rotate wheat so that no stored product is older than 5 years. However, older stored wheat can make acceptable bread. A BYU study indicated that, regardless of headspace oxygen level, wheat packaged in No. 10 cans throughout 32 years of storage at ambient or cooler temperatures made bread acceptable to a majority of consumers.

INSECT CONTROL RECOMMENDATIONS

Method	Insect Control Recommendation
Insecticides	NOT RECOMMENDED, may be toxic if not correctly used.
Heating	NOT RECOMMENDED, too difficult to control the correct amount of heat to apply.
Bay leaves, nails or salt	NOT RECOMMENDED, these have absolutely no effect on insects or insect eggs.
Freezing	Freeze 1-15 lb bags of wheat for 2-3 days. Allow to warm for 24 hours. Freezing kills live pests, but not insect eggs. Multiple freezing and warming cycles may be needed to kill all insects and hatching eggs.
Vacuum sealing	Seal wheat in vacuum bags following vacuum sealer instructions. Regular polyethylene bags are not suitable to maintain a vacuum.
Dry ice (CO_2)	Place 3-4 inches of grain in the bottom of a 5-gallon plastic bucket. Use gloves when handling dry ice. Add 2-3 oz crushed dry ice. Fill the container to the full height. Place the lid on top slightly askew. After 30 minutes, seal the lid air-tight. Dry ice will control most adult and larval insects present, but usually will not destroy eggs or pupae. If properly applied, a single treatment with dry ice is sufficient for long-term storage. Annual dry ice treatments are not necessary unless an infestation is recognized in the stored grain. Treating grain with dry ice does not reduce its ability to sprout or its food value.
Oxygen absorbers	Seal wheat in Mylar®-type bags or No. 10 cans along with appropriate number of oxygen absorber packets to create an oxygen-free atmosphere. This will kill adult insects and prevent larval insects from surviving.
No treatment	Choose insect-free sources for wheat. Store wheat in clean and dry containers impermeable to insects.

* Polyethylene bags and 5-gallon plastic buckets will not maintain an oxygen-free environment after dry ice or oxygen absorber treatment. Over time, oxygen will re-enter the container and this may allow larvae to grow to adults and cause an infestation during storage.

WHEAT NUTRITION

16 g Serving	Hard Red	Hard White	Soft White	Soft Red
Calories	57	53	53	53
Calories from fat	3	1.5	3	2
Fat	0.35	0.15	0.35	0.25
Total carbohydrates	11	11	11	12
Dietary fiber	1.7	2	2	2
Protein	2.3	2	2.3	1.7

NUTRITION

A typical serving of whole wheat is 16 grams. It is recommended that adults get at least three servings (48g) per day. Wheat grain is high in protein, fiber, calcium, and iron. Spouting wheat can obtain small amounts of vitamins A, B, C, and E not present in whole grain wheat. Other health claims for sprouted wheat remain unsubstantiated and lack science-based credibility.

ALLERGIES: Some people are allergic to wheat proteins. The allergy can cause a variety of symptoms due to an autoimmune inflammation of the digestive system, such as diarrhea, bloating, constipation, and pain. Ulcerative colitis and irritable bowel syndrome may be caused by a food allergy. A severe allergy can result in life-threatening anaphylactic shock. In some, the allergy is life-long and non-reversible and is called "celiac's disease." Other people may be simply "intolerant" to wheat. In this case they suffer from symptoms, but there is not an immune response. People with minor allergic reactions or intolerances can lose them over time. Always seek the advice of a physician to help with any allergies. All varieties of wheat and processed wheat (flour, germ, cracked, etc.) contain the allergy proteins.

USE FROM STORAGE

Stored wheat can be ground for flour, popped (like popcorn), steamed, or cracked and cooked. Some like to germinate and sprout wheat for wheat grass.

WHITE RICE

INTRODUCTION

White rice (a name given to milled raw rice that has had the hull, bran, and germ removed) is a popular commodity found on the shelves of many food storage programs. Once the milling is complete, the rice is then polished. You will often see the term "polished rice" associated with white rice as well. This process does alter the color, flavor, and even nutrition of the rice, but results in a bright white rice that stores better for a longer time. Because the nutrients have been altered, manufacturer's in the United States are required by law to add nutrients back into the rice. This rice is then known as "enriched" white rice. By law, manufacturer's must enrich with vitamins B1, B3, as well as mineral iron.

White rice is inexpensive, stores easily, is easy to prepare, versatile, and well liked by most people. This makes it a great food storage commodity.

The general recommendation for the amount of grain to store is about 300 lbs per person, per year. Part of that grain is often rice. Depending on personal preference, about 25 to 60 lbs of rice should be stored per person.

QUALITY & PURCHASE

Purchase quality rice grains from a trusted source. Inspect rice for insects or discoloration, prior to preparing for home storage. Do not buy rice with any visible signs of insect infestation.

There are three main types of white rice in the United States: long, medium, and short grain. In addition, there are several types of specialty rice available.

Long Grain: Long grain polished rice is about three times longer than it is wide. After cooking, it is firm, fluffy, and not sticky.

Medium Grain: Medium grain polished rice is between two and three times longer than it is wide. Cooked U.S. medium grain rice is soft, moist, and sticky in texture.

Short Grain: Short grain rice is less than two times longer than it is wide. Short grain rice is very sticky and sometimes called sushi rice.

Specialty Rices: These include Arborio, Basmati, Della or Dellmont, Japanese premium, Jasmine, Toro, and Waxy. Analyses on which variety stores best have not been done.

PACKAGING

Packaging for white rice varies, depending on the vendor. Grocery stores will typically carry the rice in plastic bags in weights up to 4 or 5 pounds. Many food storage suppliers (not grocery stores) package rice in cans or well-sealed pouches,

both of varying sizes. Big box, or "warehouse" type stores, typically carry rice in 25-50 lbs paper or mesh bags.

For long-term storage, it is important that the packaging prevent moisture and rodent/insect damage. This means that many consumers may need to transfer the white rice they purchase into different containers for storage.

Store rice in a tightly sealed container. Food safe plastic (PETE) containers, glass jars, No. 10 cans (commercial size) lined with a food-grade enamel lining and Mylar®-type bags work best for long-term storage. Use food-safe oxygen absorbers available from food storage supply stores to preserve rice quality and protect from insect infestation. No. 10 cans will hold about 5.7 lbs (2.6 kgs) of polished rice.

One recommendation, used by many when purchasing rice in smaller quantities, is to place the bags of rice in the freezer for three days. This will kill any insect (or insect larvae) that might be present. Once removed from the freezer allow the rice to come to room temperature before placing in an airtight container.

STORAGE CONDITIONS AND SHELF LIFE

White rice, like so many of our other food storage items, does best stored in clean, cool, and dry conditions. It is important to keep the food in as cool a temperature as possible, without freezing. A temperature range of 40° to 60° F is ideal, but probably not possible for most home storage conditions. These cool conditions insure longevity of overall quality and nutrient retention.

The shelf life for optimum quality and nutrition of white rice is 25-30 years, depending on storage temperature, and if sealed in containers using oxygen absorber packets.

NUTRITION

White rice is low in sodium, contains no cholesterol, and has no fat.

WHITE RICE, COOKED, LONG GRAIN-ENRICHED (1 CUP)

Energy	206 kcal
Carbohydrates	45 g
Sodium	2 mg
Fat	0.0 g
Protein	4 g
Cholesterol	0.0 mg
Dietary Fiber	1 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/**

ALLERGIES: There are no known common allergens associated with rice, making it a good grain choice for so many people with wheat intolerance, Celiac, or other similar concerns.

USE FROM STORAGE

Use white rice within 1-2 years after opening.

White rice, for the majority of cooking needs, does not require washing before cooking. Recipes using other types of rice (such as Basmati or Japanese) may suggest not only washing, but also soaking. Soaking removes some of the extra starches.

The most common preparation for white rice is to boil/steam it.

Place one cup of white rice in 1 ½ cups-2 cups of boiling water in a saucepan. Place a lid on the pan and reduce heat to maintain a low boil for 20 minutes. Remove from heat and let the rice sit another 5 minutes. Remove lid and fluff the rice with a fork. Serve. For food safety, refrigerate unused cooked rice within 2 hours.

BROWN RICE

INTRODUCTION

Brown rice refers to rice that is almost completely intact. This means that it has not been polished and only the hull has been removed. The germ and bran of the rice remain, which is not the case in white rice. This makes brown rice a whole grain.

According to the *2010 U.S. Dietary Guidelines for Americans and My Pyramid,* the recommendation is to eat half our grains whole, or at least three servings a day of whole grains. Brown rice is considered a 100 percent whole grain food, and because of its mild nutty flavor and chewiness, it has become a popular rice choice.

QUALITY & PURCHASE

Brown rice is available pre-packaged, in both large and small quantities, and loose from bins. Purchase quality rice from a reputable source. Inspect rice for insects or discoloration prior to preparing for home storage. Do not buy rice with any visible signs of insect infestation.

Like white rice, brown rice is classified in three main types according to its size and texture: long grain, medium grain, and short grain.

Long Grain: Long grain rice is a slender kernel about three to four times longer than it is wide. Long grain brown rice, when cooked, is usually more light and fluffy than the other types, and is less sticky because the kernels stay more separated in cooking.

Medium Grain: This kernel of brown rice is about two to three times longer than it is wide. These grains are moist and tender when cooked, but do have a tendency to stick together.

Short Grain: This type of brown rice has a short, almost round kernel, and looks a little plump. When cooked these grains are tender, but stick together, and are usually chewy.

Specialty Rices: These are red, black, and purple rice. Each of these has a little different nutrient content and pigmentation, but all are very similar to brown rice in fiber.

The general recommendation for the amount of grains to store is about 300 lbs of grains per person/year. Part of that grain recommendation is often rice. The one challenge for long-term storage of brown rice is the shelf life…brown rice goes rancid quickly. (See Storage Conditions and Shelf Life Sections for more details.)

PACKAGING

Packaging for brown rice varies, depending on the vendor. Grocery stores will typically carry the rice pre-packaged in

plastic bags in weights up to 4 or 5 pounds. Many food storage suppliers of rice (not grocery stores) package rice in cans or well-sealed pouches, both of varying sizes.

For long-term storage it is important that the packaging must prevent moisture and rodent/insect damage. This means that many consumers may need to transfer the brown rice into different containers for storage.

Store rice in a tightly sealed container. Food safe plastic (PETE) containers, glass jars, No. 10 cans (commercial size) lined with a food-grade enamel lining and Mylar®-type bags work best for long-term storage. Use food-safe oxygen absorbers available from food storage supply stores to preserve rice quality and protect from insect infestation. A No. 10 can will hold about 5.7 lbs (2.6 kgs) of polished or brown rice.

One recommendation used by many, when purchasing rice in smaller quantities, is to place the bags of rice in the freezer for 3 days. This will kill any insect (or insect larvae) that might be present.

STORAGE CONDITIONS AND SHELF LIFE

The bran layer of brown rice contains a small amount of oil, and it is this oil that can go rancid in storage, so the shelf life for brown rice is only a few months. Brown rice should be stored in a dry, cool, and dark environment; preferably in temperatures of 40˚ F or below to lengthen shelf life. Brown rice stored at 70˚F (room temperature) can be stored for up to 6 months (Boyer, 2009). Another way to extend shelf life is to store the rice in the refrigerator or freezer.

NUTRITION

Brown rice has more fiber than white rice, due to the difference in the way the two are processed. Brown rice does not have the husk removed so the bran is kept intact, providing more fiber. White rice is polished, is either pre-cooked or parboiled, removing the bran.

Brown rice is the only form of rice that contains vitamin E. It also contains magnesium, manganese (88 percent of our daily value), selenium, and zinc. While white rice also contains these nutrients, brown rice has a higher amount.

BROWN RICE, COOKED, LONG GRAIN (1 CUP)

Energy	206 kcal
Carbohydrates	45 g
Sodium	2 mg
Fat	0.0 g
Protein	4 g
Cholesterol	0.0 g
Dietary Fiber	1 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/**

ALLERGIES: Like white rice, brown rice is gluten free, so is not a commonly allergenic food and is actually a great alternative for individuals with gluten or wheat allergies.

USE FROM STORAGE

Brown rice takes longer to cook than white rice. Plan on about 45-60 minutes. The bran layer hinders water from soaking into the kernel (Filipic, 2010). Brown rice can be used in place of white rice in most recipes and gives a nutty flavor and more chewy texture.

Cooked rice is a potentially hazardous food and should be held at proper temperatures. Hot rice should be held at 135° F or above. Cool rice to 70° F within 2 hours; cool from 70° F to 40° F within an additional 4 hours. Cold rice should be held at 41° F or below (USDA, n.d.). In each storage container, limit the depth of rice to 2 inches and cover loosely in the refrigerator. Once the rice has cooled completely, seal the container (Crum, 2011). Large amounts of brown rice can be cooked, repackaged into smaller containers, and placed in a freezer for storage. These smaller amounts of rice can be easily reheated in the microwave (Dinstel, nd).

A rice cooker makes fluffy brown rice. Fluffy brown rice can also be made in the oven if there is no rice cooker available (Crum, 2011).

OATS

INTRODUCTION

Oats have been around for hundreds of years, and while mostly used for animal feed even today, we have learned they are a remarkably healthy food. Oats are a hardy cereal grain able to withstand poor soil conditions in which other crops are unable to thrive. Oats get part of their distinctive flavor from the roasting process that they undergo after being harvested and cleaned. Although oats are then hulled, this process does not strip away their bran and germ, thus allowing them to retain a concentrated source of fiber and nutrients. Oats come in a variety of forms, each having benefits.

Oat groats: are the whole oat grain, with only the hard unpalatable outer hull removed. They are good for using as a breakfast cereal or for stuffing.

Steel-cut oats (also called Scotch or Irish oats): featuring a dense and chewy texture, are produced by running the groats through steel blades that thinly slices them.

Rolled oats: sometimes called old-fashioned oats, have a flatter shape that is the result of the groats being lightly steamed and then rolled.

Quick-cooking oats: are the steel-cut oats that are processed like old-fashioned or rolled oats.

Instant oatmeal: produced by partially cooking the grains and then rolling them very thin. Oftentimes, sugar, salt, and other ingredients are added to make the finished product.

Oat bran: the outer layer of the grain that resides under the hull. While oat bran is found in rolled oats and steel-cut oats, it

may also be purchased as a separate product that can be added to recipes or cooked to make a hot cereal.

Oat flour: used in baking, it is oftentimes combined with wheat or other gluten-containing flours to make leavened bread.

QUALITY AND PURCHASE

Oats are generally available for purchase in prepackaged containers as well as bulk bins. Just as with any other food from bulk bins, make sure that the bins containing the oats are covered and free from debris. Whether purchasing oats in bulk or in a packaged container, make sure there is no evidence of moisture. As with all grains, store oats in airtight containers in a cool, dry, dark place, and protect oats from insects and rodents.

PACKAGING

Rolled oats (both regular and quick cooking) and steel cut oats are available in retail stores in sealed cans with oxygen removed. Oat groats and all other forms of oats may also come packaged in sturdy cardboard canisters, plastic bags, and heavy

burlap or brown paper bags. While these packages are fine for transporting, they are not intended to be sufficient protection from moisture, rodents, or other elements for long-term storage.

STORAGE CONDITIONS AND SHELF LIFE

Store oats in a cool, dark, dry place. Store them in airtight containers, which include Mylar® bags, food storage buckets, and sealed cans. Use oxygen absorber packets for long-term storage. This aids in extending shelf life, but more importantly keeps insects from surviving if present in the food.

Grains purchased for short-term storage can be heat/cold treated to help reduce the risk of insect infestation. Heat in a shallow pan in the oven at 120° F for 1 hour or at 130° F for 30 minutes, place in a deep freezer at 0° F for 4 days, or heat in the microwave for 5 minutes. However, seeds saved for planting may have the germination reduced by super heating, cooling, or microwave methods (Lyon, 1997).

Properly stored oats can have a shelf life of up to 30 years. A recent BYU study found that oats stored in No. 10 cans for up to 28 years had little change in the nutritional value and taste (McEwan, 2003).

Develop a plan to use stored oats on a regular basis. As stored oats are used, replace them with new purchases that have been labeled with the date of purchase. A good rule of thumb is to rotate oats regularly so that your stored oats do not get too old and your family gets used to eating them on a regular basis. After opening, store oats and oatmeal in airtight containers.

NUTRITION

Oats have been referred to as a cleansing grain because of their relatively high soluble and insoluble fiber content. They cleanse both your blood and your intestinal track. Eating high-fiber foods, such as oats, can help reduce high cholesterol, can help reduce the risk of breast cancer, can help lower blood sugar for people with type II diabetes, and can help prevent heart disease. Antioxidant compounds unique to oats, called avenanthramides, help prevent free radicals from damaging LDL cholesterol, which can reduce the risk of cardiovascular disease.

Oats are a very good source of manganese and selenium, as well as a good source of dietary fiber, magnesium, zinc, and phosphorus. Oats are also rich in the B vitamins and contain the antioxidant vitamin E.

OATS, REGULAR AND QUICK, NOT FORTIFIED 1 CUP (81G)

Energy	307 kcal
Carbohydrates	56 g
Sodium	5 mg
Fat	5 g
Protein	11 g
Cholesterol	0.0 mg
Dietary Fiber	8 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/**

ALLERGIES: An oat allergy, commonly referred to as "oat sensitivity," is a condition in which a person's body is intolerant to a protein found in oats called avena sativa. A person can be sensitive to the oat protein internally or externally. Oat allergies are relatively rare, and mostly occur in young children who often outgrow it.

USE FROM STORAGE

The cooking and use of oats from storage will depend on its form. Quick cooking oats can be cooked for cereal in just a couple of minutes, and even regular rolled oats only take about 10-15 minutes.

Rolled oats are often added to meat loaf to not only help serve as a binder, but as a meat extender. Oats can be ground to make oat flour, which is good in baking muffins, cookies, and breads, but also as a thickener for soups, gravies, and stews. When used in baking, substitute 1/3 of the all purpose flour called for in a recipe with the oat/oatmeal flour (Dickson, 2008).

POPCORN

INTRODUCTION

Popcorn, a whole grain product, has been around for thousands of years. The oldest discovered ears of popcorn were in a bat cave west of central New Mexico in 1948, and they are more than 5,500 years old. Popcorn has also been excavated out of tombs in South America; and it was so well preserved, that it still popped. (Grain Information, 2012). During WWII popcorn was sold as a "candy" replacement for the lack of sugar in America. Today the average American will consume 49 quarts of popped corn a year (Popcorn Board, 2013).

QUALITY & PURCHASE

Popcorn is sold either as a plain or flavor-added popped product or as an unpopped product in moisture-proof containers ranging from plastic bags and sealed jars to ready-to-use containers both for conventional and microwave popping. Popcorn flavor is enhanced to individual tastes with the addition of salt and butter (Carter, 1989).

According to the Gale Research of 1996 for encyclopedia.com, popcorn is the only corn that pops; it is not dried kernels of sweet corn. There are several popular varieties of popcorn and thousands of hybrids.

White hull-less and yellow hull-less are the varieties sold most commonly and packaged in microwave bags.

Rice popcorn is a variety with kernels that are pointed at both ends.

Pearl popcorn produces round, compact kernels.

Strawberry popcorn has tiny red ears that are shaped like strawberries and produce red kernels.

Black and blue varieties of popcorn have colored grains that pop as white kernels.

Rainbow or Calico corn has white, yellow, red, and blue kernels.

STORAGE CONDITIONS & SHELF LIFE

Store popcorn the same as most grains. Keep the kernels in a cool, dry location. Choose containers that protect the popcorn from insects, rodents, and moisture. When popcorn is stored in ideal conditions, it has an indefinite shelf life. however, for best results, store in airtight containers and use within 1 year of purchase.

NUTRITION

Popcorn, a whole grain, can be a healthy snack. Popcorn contains substantial amounts of carbohydrates, fiber, many of the B vitamins, potassium, phosphorus, magnesium, iron, zinc, pantothenic acid, copper, manganese, linoleic acid,

polypheonls (anitoxidants), and all the essential amino acids. When air popped or served with light butter, it is low in calories and high in nutrition (McAdams, 2011).

POPCORN POPPED NUTRITION VALUE PER 100 g (3.5 oz)

Calories 1 cup	31
Carbohydrates	6 g
Sodium	1 mg
Fat	1 g
Protein	1 g
Sugars	1 mg
Dietary Fiber	1 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/snacks/5659/2**

USE FROM STORAGE

Popcorn can be ground into corn flour, leaving the germ intact. The grinding process exposes the oils to air and they break down quickly. Only grind as much as you need for a recipe since ground popcorn does not store well (Rose, 2011).

Another use for popcorn is to make flour out of popped kernels. To make this flour, place popped popcorn into a blender and blend until it resembles flour. A medium texture takes about 20 seconds, but continue blending 40 to 50 seconds for fine flour. During World War II, when wheat was in short supply, people combined popcorn flour (25 percent) and wheat flour (75 percent) for use in their recipes.

Popcorn that pops poorly with many unpopped kernels is probably too dry and needs moisture. Start by adding one tablespoon of water to a quart of popcorn, mix well a couple of times that day, then after 2-3 days, try popping another sample. Continue this procedure until the popcorn pops well (Carter, 1989).

LENTILS

INTRODUCTION

Lentils are seeds of plants that are classified as legumes. They grow in pods that contain round and oval small seeds. They are cousins to the bean plants. Lentils are a dried legume often called a pulse and are various colors of reds, yellows, with green and brown. Lentils are sold whole or often split in half.

Lentils are easy and quick to prepare (10-30 minutes to rehydrate). They absorb water quickly and also absorb the flavors of seasonings and foods they are combined with. This makes lentils useful for soups, meats, breads, and other foods.

The origin of lentils is central Asia. Lentils are one of the earliest foods to be grown and harvested. Seeds as old as 8,000 years have been dated when found in archeological digs in the Middle East. The leading producers of lentils today include India, Turkey, Canada, Syria, and China. Lentils are also grown in several northwestern states in America.

QUALITY & PURCHASE

Lentils are available year round in prepackaged containers and in bulk packaging. When purchasing, check containers for lack of evidence of insects or moisture. Lentils should be whole and not cracked, though they may be halved. Canned lentils have the same nutritional value as dry.

STORAGE CONDITIONS & SHELF LIFE

Lentils should be stored in airtight containers in cool, dark, dry conditions. For best color and flavor, use lentils within 12 months. Storing lentils in temperatures within 50-70

degrees and in moisture-free areas will lengthen their shelf life. Research indicates that lentils are an ideal long-term (20-30 years) food storage product. Lentils may have an indefinite shelf life, when stored in No. 10 cans or airtight containers and in ideal cool, dry, and dark conditions.

Cooked lentils will keep in the refrigerator in a sealed container for 3-5 days and may be frozen for 6 months.

NUTRITION

Lentils are high in nutritional value, low in fat, high in fiber, (both soluble and insoluble) and a good source of protein. They are also rich in folate and a good source of potassium. Legumes are recognized for their role in promoting good health. Researchers find that they may reduce heart disease, diabetes, and some cancers.

LENTILS, RAW (DRY WEIGHT) NUTRITION VALUE PER 100 g (3.5 oz)

Energey	353 kcal
Carbohydrates	60 g
Sugars	2 g
Fat	1 g
Protein	26 g
Folate	479 mg (120 percent)
Dietary Fiber	31 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/legumes-and-legume products/4439/2#ixzz2RW9oJQSc**

USE FROM STORAGE

Lentil preparation: Lentils do not need to be presoaked. Prior to cooking, spread lentils out and remove any stones or debris. Lentils can then be washed under cool water and put with water for cooking. Bring lentils to a boil, then simmer. Red lentils will rehydrate quicker than green. Lentils require 10-30 minutes to rehydrate.

These following measurements will be helpful in rehydration, usage, and storage:

- 1 cup dry lentils + 1 cup water = 2 to 2 1/2 cups cooked
- 1 pound dried lentils = 2 1/4 cups dry
- 1 pound dried lentils = 5 cups cooked

Lentils can also be very useful when ground into flour. They are gluten free.

Note: Lentils with husk remain whole with moderate cooking; lentils without husk tend to disintegrate into a thick purée, which makes quite interesting dishes.

BARLEY

INTRODUCTION

Barley is grown in the U.S. and commonly used as a grain for human consumption, for malt in alcoholic beverages, and for animal feed. Whole grain barley consists of the bran, endosperm, and germ, which are still connected. Hulled and hulless are two forms of whole grain barley. Hulled barley goes through little processing with only the outer hull removed and is the most nutritious. With hulless barley, the hull is loosely connected and usually falls off after being harvested. This requires little to no processing to remove the outer hull, leaving most of the bran, endosperm, and germ still intact (Conway, 2006).

Varieties: The varieties of barley that can be purchased for human consumption are pearled barley, quick barley, barley flour, barley flakes, and barley grits. The process that pearled barley goes through consists of the removal of the inedible hull and bran layers; the quantity of layers removed determines if the pearled barley is regular, medium, fine, or baby pearl (Lemaux, 2007). This process causes the barley to lose a lot of nutrients; however, it cooks faster and the taste and texture is usually preferred (Beck, 2013). Quick barley is the instant form of pearled barley that is steamed before packaging, and it has the same nutritional content as pearled barley. Flour can be made from pearled grain through milling. Flakes are made from pearled barley but are steam rolled and dried. Grits are the small pieces of pearled barley.

QUALITY & PURCHASE

Barley can be purchased in the forms of pearled, hulled, and flaked. Purchase barley that is clean, dry, free from debris,

and fresh smelling. Pearled barley may be the easiest form of barley to find. All varieties may be found at health food stores.

PACKAGING

Barley should be stored in food-grade packaging, that is moisture-proof, like Mylar® bags, polyethylene bags, plastic buckets, or No. 10 cans.

STORAGE CONDITIONS & SHELF LIFE

The recommended shelf life of barley is 2 years. Barley should be stored in temperatures below 60° F with moisture content of less than 12 percent (Barley Facts, 2007).
For a longer duration of storage, barley should be kept at even cooler temperatures and lower moisture content. A long-term shelf life would be for only 8 years because of the softness of the outer shell (Portela, 1999).

NUTRITION

Barley contains gluten, so it should be avoided by those individuals with celiac disease and gluten intolerance. In ¼ cup of uncooked pearl barley, there is on average 2.5 g of beta-

glucan soluble fiber; but individual barley labels should be referred to for specific soluble fiber contents (Barley Facts, 2007).

BARLEY NUTRITION

Calories (1 cup)	193
Carbohydrates	44 g
Sugars	0 g
Fat	2 g
Protein	4 g
Sodium	5 mg
Dietary Fiber	6 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: http://nutritiondata.self.com/facts/cereal-grains-and-pasta/5680/2

ALLERGIES: Compared to oats and wheat, barley has a higher percentage of beta-glucan content because beta-glucan is throughout the whole barley kernel. The beta-glucan in other grains is only in the bran layer and is removed when the bran is removed. Even products that are refined, like barley flour, contain beta-glucan (Conway, 2006).

Barley Nutrtion: Barley is high in fiber, selenium, iron, and niacin. Studies have shown that barley is more effective in lowering blood cholesterol than wheat or rice because of its beta-glucan content. For best health benefits from barley, 3 grams of beta-glucan should be consumed each day.

USE FROM STORAGE

Barley should be rinsed before cooking. Hulled barley will take longer to cook than pearled barley. Barley flour can be combined with wheat flour to make baked goods. It can't be substituted on its own, because it doesn't have a strong enough gluten content. Barley flakes and cracked barley can be used for hot cereal. Barley can also be added to salads and stews.

QUINOA

INTRODUCTION

Quinoa originally came from the Andes Mountains of Bolivia, Chile, and Peru and is pronounced KEEN-WAH, known as Incan rice. Quinoa is in the same family as sugar and table beets and spinach (Oelke, 1992). Quinoa is known as a pseudocereal grain, because it produces fruits and seeds but is not of the grass family.

There are more than 120 different varieties of quinoa, but the most commonly known types are white, brown or red, and black quinoa (Whole Grains Council, 2013). Quinoa has a reputation of being superior to other cereal grains because of its nutritional value and taste. Quinoa has a nutty flavor and a fluffy and chewy texture (Whole Grains Council, 2013).

QUALITY & PURCHASE

The quinoa seeds have a bitter taste that comes from the saponin in the outer coat, but that coat is removed before consumption by either rinsing or mechanically removed by manufacturers (Grain Information, 2012). Quinoa can be purchased at grocery stores, health food stores, and online.

STORAGE CONDITIONS & SHELF LIFE

There does not seem to be any specific temperature requirements for quinoa, but the USDA suggests the following guidelines for storing cereals: cereals should be stored at 50° F. for maximum shelf life, but 70° F is also acceptable for dry storage of most products (Department of California Education, 2013).

Quinoa is a soft grain with high amounts of polyunsaturated fat compared to other grains. Because of this, there is much speculation on how the fat affects the shelf life of quinoa because of lipid oxidation. It is believed that the high levels of vitamin E, an antioxidant in quinoa, may counteract the lipid oxidation; however, there is limited information on the shelf life and lipid oxidation of quinoa (Jancurova, 2009).

NUTRITION

Compared to other common grains like wheat, rice, corn, and barley, quinoa is higher in protein and fat content (Ng, 2003). The high fat content is due to the high amounts of the polyunsaturated fatty acid, linoleic acid, which is a health-promoting fatty acid.

All ten of the essential amino acids are found in quinoa. Amino acids are building blocks to proteins in the human body. Essential amino acids are those that can't be made in the body, so they have to be consumed through the diet. Because of the high essential amino acid content in quinoa, it can be compared to casein, the protein in milk. The amount of amino acids in quinoa is higher than other common cereals (Vega-Galvez, 2010).

QUINOA, COOKED
NUTRITION VALUE PER 185 g

Calories 1 cup	222
Carbohydrates	39 g
Sodium	2 g
Fat	4 g
Protein	8 g
Folate	479 mg (120 percent)
Dietary Fiber	5 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: http://nutritiondata.self.com/facts/cereal-grains-and-pasta/10352/2

Quinoa is high in calcium, magnesium, iron, copper, and zinc; higher than most grain crops. However, the amount of mineral content depends on the soil that it is planted in. Some soils produce a higher mineral content. It is also high in vitamins C and E, thiamin, riboflavin, and niacin (Vega-Galvez, 2010).

Quinoa is high in the polyunsaturated fatty acid, linoleic acid, which is an essential fatty acid, meaning that it can't be made in the body. Polyunsaturated fatty acids help to prevent cardiovascular disease and improve insulin sensitivity. It has a low glycemic index, which is a great alternative for those with diabetes (Vega-Galvez, 2010).

ALLERGIES: Quinoa is generally considered gluten free. However, new research indicates that it may contain other protein properties that activate the immune system. So this may be one to avoid if you have celiac disease (American Journal of Clinical Nutrition, 2012).

USE FROM STORAGE

Quinoa can be toasted, used as a substitute for rice and other grains, or ground into flour to make pasta, breads, pancakes, crackers, and other baked goods. Also, the seeds can be sprouted or popped like popcorn (Jancurova, 2009).

SPELT

INTRODUCTION

Spelt is a whole grain that comes from the wheat family. It has been around for thousands of years but was introduced to the United States in the 1890s. Its grain contains the bran, the outer covering of the kernel, the germ, which contains oil, and the endosperm, which is the starchy part of the kernel. Spelt is similar to wheat in taste and texture but has a sweeter and nuttier flavor and is heavier and denser than wheat (Lamb, 2010). When it comes to identifying the different varieties of spelt, there has been a lot of confusion because there are so many different types and because the soil and the environment that it is grown in impacts its quality and profile (Roth, 2008).

QUALITY & PURCHASE

When harvested, spelt stays attached to its protective covering, the hull, until right before milling. The hull protects against soil-borne pathogens (Wilson, 2008). Spelt can be purchased through organic and health food stores in bin containers or prepackaged.

STORAGE CONDITIONS & SHELF LIFE

Spelt is a hard grain much like winter wheat. It should be stored in a dry area with the moisture level no greater than 14 percent and a temperature below 55˚ F. Spelt flour should be refrigerated to preserve the nutritional value and freshness. If the temperature of the grain is kept below 55˚ F., and in optimal conditions, spelt can be stored for up to 30 years (BYU study, 2008).

NUTRITION

The nutrition of spelt is similar to wheat flour except that spelt contains more riboflavin and niacin (B vitamins) than wheat.

1 CUP UNCOOKED SPELT

Calories 174g	558
Carbohydrates	124 g
Sodium	14 mg
Fat	4 g
Protein	25 g
Sugars	12 g
Dietary Fiber	19 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: http://nutritiondata.self.com/facts/legumes-and-legumeproducts/4439/2#ixzz2RW9oJQSc

ALLERGIES: Because spelt contains gluten, individuals with celiac disease are not able to safely consume it. However, spelt may be an alternative to those allergic to wheat; but individuals should check with their physician first before substituting it for wheat. Also, research has shown that spelt may be easier for humans to digest than wheat (Bastin, 2010).

USE FROM STORAGE

Spelt flour can be used instead of, or in conjunction with, wheat flour in recipes such as breads, pastas, cookies, crackers, cakes, muffins, and waffles. Rolled or flaked spelt can be cooked and eaten like a hot cereal.

SPLIT PEAS

INTRODUCTION

Dried peas, also known as pulses, are nutrition packed. Pulses are the dried seed from a plant grown from the legume family. Dried peas have been consumed since prehistoric times with the remains of peas being found at fossilized archeological sites. The cultivation of dried peas dates back to 2,000 BC where they were consumed by the Chinese. Modern day split peas are thought to have originated from the field pea, native to Europe and Asia. Dried peas were introduced to the Americas with the early colonists.

Dried peas are a starchy, hardy legume available year round. Dried peas are harvested from a fully mature peapod that has been dried. When the skin of the dried pea is removed, the seed splits.

QUALITY & PURCHASE

Two varieties of dried peas are available, green and yellow. Yellow peas have a milder flavor than green peas which are richer and stronger.

Dried peas can be purchased as split or whole in prepackaged bags as well as in bulk containers. Choose peas that are free of cracks and debris.

STORAGE CONDITIONS & SHELF LIFE

Dried peas that are stored in the plastic bags they were purchased in will have a shelf life of only about 1 year. But if properly stored in an airtight sealed container with oxygen absorbers, the shelf-life can be extended to 20 years or more.

Dried peas need to be stored in cool, dark conditions to prevent them from losing their yellow and green colors and turning a light gray.

NUTRITION

Dried peas, like other legumes, are rich in soluble fiber and insoluble fiber. Soluble fiber forms a gel-like substance in the digestive tract that binds bile (which contains cholesterol) and carries it out of the body. Dried peas are a very good source of cholesterol-lowering soluble fiber (Bazzano et al., 2003).

Research studies have shown that insoluble fiber not only helps to increase stool bulk and prevent constipation, but also helps prevent digestive disorders like irritable bowel syndrome and diverticulitis (Liu, 2004). A single cup of cooked dried peas provides 65 percent of the daily value for fiber.

ALLERGIES: Not only can dried peas help lower cholesterol, they are also of special benefit in managing blood-sugar disorders since their high fiber content prevents blood sugar levels from rising rapidly after a meal (McIntosh and Miller, 2001).

DRIED PEAS RAW (DRY WEIGHT) NUTRITION VALUE PER 145 g (1 CUP)

Energy	376 kcal
Carbohydrates	21 g
Sugars	8 g
Fat	1 g
Protein	8 g
Folate	94.3 mcg
Dietary Fiber	7 g

Percentages are relative to U.S. recommendations for adults. Nutrient data for this listing was provided by USDA SR-21. Nutrition Data. Available at: **http://nutritiondata.self.com/facts/legumes-and-legume products/4439/2#ixzz2RW9oJQSc**

USE FROM STORAGE

Before using dried split peas, inspect and remove any debris or dirt. Split peas will not need to be presoaked like other dry legumes. Simply put peas into the soup or stew you are making and they will cook in a reasonable amount of time. To prepare split peas that are not part of a soup or stew, place the legumes in a saucepan using 3 cups of fresh water for each cup of peas. Bring to a boil, then reduce to a simmer and cover. Usually split peas only take about 30 minutes to cook. Foam may form during the first 15 minutes of cooking. It can simply be skimmed off.

Split peas may also be ground into pea flour to use as the basis for some pea soup recipes. This allows the peas to cook faster and will thicken the soup as it cooks. Peas are an excellent protein substitute for egg products.

MISCELLANEOUS FOOD STORAGE

IN THIS SECTION

SUGARS

INTRODUCTION

Sugars are simple carbohydrates that provide an excellent source of calories for energy. Sugars also add the sweet taste to many of our most delicious foods. Sugar can be stored in dry form (crystals) or in a liquid form (syrup –including maple syrup). Sugar from beets or sugarcane (sucrose), corn (dextrose), and honey (fructose) are most commonly used for long-term food storage. The use of sugarcane for sugars dates back centuries B.C. Some of the earliest cultures grew the canes and squeezed the sweet juice from them after harvest. Even in those days, the juice was allowed to dry and was used as a solid. Centuries later the juice would be dried in a manner that resulted in crystals. These crystals would store indefinitely. Sugar beets are another source of sucrose. The sugar beet was named the historic state vegetable in Utah in 2002. From the 1880s until 1980, sugar beets significantly contributed to the Utah economy.

QUALITY & PURCHASE

Pure cane or beet granulated sucrose (table sugar) stores the best. Powdered sugar is simply table sugar ground to a finer powder. It can be stored the same as granulated sugar. Brown sugar is either white sugar with caramel coloring or white sugar with some molasses residue. It often has a little higher moisture content than table sugar, making it sticky. Purchase top quality refined sugar from trusted commercial sources. Raw sugars and honey that are less "pure" will have a shorter quality shelf life. Commercial, filtered liquid honey will last the longest in storage. Select filtered, top quality syrups or honey for storage. Comb honey, unfiltered honey, or raw sugar syrups do not store as well. Brown sugars that have natural moisture do not store as well long-term.

PACKAGING

Storage containers should be opaque, airtight, and moisture/odor proof. The typical retail paper package for crystal sugars is not suitable for long-term storage. Polyethylene bags, Mylar®-type bags, food-grade plastic buckets, glass canning jars, and No. 10 cans are all suitable for dry sugar storage. Glass canning jars and No. 10 cans work best for liquid syrups and honey. However, honey is acidic and can acquire a metallic taste from the metal can after many years of storage. The main metal in food cans is tin. Tin, when ingested in enough quantities, can cause gastric irritation, nausea, vomiting, abdominal discomfort, and diarrhea. However, these symptoms should not prevent someone from using metallic tasting sugars during emergency situations. However, if sugar acquires a metallic flavor during storage, it should be discarded and replaced (European Commission Health & Consumer Protection Directorate-General, 2001).

STORAGE CONDITIONS & SHELF LIFE

Store sugar in a cool, dry location (not the refrigerator). Moisture makes granulated sugar hard and lumpy. Once this happens, it creates problems in usage and there is no easy method to restore lumpy sugar. Always store all sugars in an odor-free area. Sugar can absorb strong odors – even through plastic packaging. Sugar syrups should not be allowed to get too hot or freeze – this will encourage crystallization. Heat will also darken color and alter flavor in sugar syrups and honey. Sugars are not susceptible to oxidation and therefore do not need oxygen absorbers. Some say that oxygen absorber use in granulated sugar promotes solidification.

Commercial sugars (granular, syrup, and honey) have an indefinite shelf life due to their resistance to microbial growth, including molds. These include dried sugar crystals, sugar syrups, honey, molasses, and pure maple syrup. However, commercial packaged sugars have a best-if-used by date of approximately 2 years for quality concerns. This is due to lumpiness or hardening in granulated sugars and crystallization of sugars in honey and syrup. Sugar is still safe to use even when lumps or crystals are present. The color and flavor of liquid sugars may change over time, but again, they remain safe to eat. Pure granulated sugars retain quality during storage the best. These may have an emergency storage shelf life from 2 to 10 years. After that time, they are usable, but flavor may be affected. Syrups do not store as well as the dried granulated sugars or honey. An estimated emergency shelf life is 2 to 5 years for molasses, corn syrup, and maple syrup.

NUTRITION

Sugars have approximately 15-20 calories per teaspoon, all in carbohydrates. Sugars will have no fat, cholesterol, fiber, vitamins, etc. Raw versions of sugars may have a few additional nutritive items, but nothing that would make them stand out.

ALLERGIES: Since sugars are carbohydrates and do not have protein, they do not cause any known allergies. They also do not cause any food intolerance.

USE FROM STORAGE

Once opened, sugars can easily be resealed or simply closed in their packaging. If granulated sugar is lumpy or hard, chop lumps in a food processor. If crystallization occurs in syrups or honey, re-liquefy them by placing the container in a larger container of hot water until the crystals have dissolved. Honey stored in metal containers that has become tainted with a metallic flavor can be consumed, but should be discarded and replaced when possible (Molan, 1992). There are some that advocate use of honey as a topical antibacterial agent. It does have antibacterial properties, but it also has properties that could promote bacterial infections and is not recommended for medical use.

VITAMINS

INTRODUCTION

Until the 18th century, the pirate and sailor diet included primarily dried meats and grains during extended voyages. In just a short period of time at sea, sailors would exhibit symptoms of malaise and lethargy (tiredness). After 3 months of voyage, they would suffer gum disease, lose teeth, have open wounds, and suffer emotional distress. Not much to sing about anymore. Today, we know they were suffering from scurvy, an absence of ascorbic acid (vitamin C) in their diet.

Scurvy is a form of malnutrition. Malnutrition is the absence of one or more critical nutrition needs. In most cases malnutrition involves the absence of calories and protein (think starvation). However, in emergency food storage each and every food stored will have calories and many will have proteins. Other malnutrition causes are vitamin deficiencies like scurvy, including beriberi, and pellagra. Beriberi is the absence of thiamine and pellagra is the absence of niacin. Beriberi is mostly seen in cultures that consumed only rice for their diet, while pellagra is mostly seen in cultures consuming only corn for their diet.

Thiamine and niacin are readily found in meats, poultry, seafood, eggs, grains, and legumes and in many of the foods stored for emergencies. And, as a consequence of beriberi and pellagra, white flour is enriched with both thiamine and niacin to replace that lost by removing the bran. Therefore, the only potential malnutrition of someone living on emergency stores of food might be scurvy.

Vitamin C is found in many fruits, especially citrus. However, food processing and storage rapidly deteriorates vitamin C to an unusable form. The heat during canning or drying fruits can destroy 10-90 percent of vitamin C. More vitamin C can be lost during storage. For example dried apple rings lost approximately 40 percent ascorbic acid over 9 months stored at room temperature in foil pouches. For that reason vitamin C (ascorbic acid) is recommended as the main supplement to have in emergency food stores. Vitamin C can also be addressed by consuming sprouts of wheat or other grasses and in fresh (short-term stored) fruits.

QUALITY & PURCHASE

Purchase vitamin C from a reputable pharmacy or health food store. There is no real need for multi-vitamins, but they certainly cannot hurt. Avoid products making unverified claims such as “emergency storage” vitamins that last 10 years. Rarely are these claims backed with evidence and most likely they are no better than the normal generic brand.

PACKAGING

Storage containers should be opaque, airtight, and moisture/odor proof. Store vitamins in their original packaging, unless that packaging looks insufficient to preclude air and moisture. It would be acceptable to overpackage vitamins in a Mylar®-type bag for added protection from the elements.

STORAGE CONDITIONS & SHELF LIFE

Store vitamins in a cool, dry location (not the refrigerator or freezer). Moisture will find its way through packaging to accelerate the break-down of vitamins. Moisture is the biggest enemy of vitamin C stability during storage (Hiatt et al., 2010).

One manufacturer, that packages vitamin C in blister packs overwrapped in foil, has a 2-year shelf life. Another manufacturer that packages pills in a plastic bottle has just a 1-year shelf life indicated. Keep in mind that the shelf life mentioned is usually where the entire dose remains (essentially 100 percent). So, vitamin C is most likely still good beyond its expiration date, but the problem is that the true percentage of remaining vitamin C is unknown. But expired vitamin C is better than none at all. There are no toxic by-products or any reason not to consume out-of-date vitamin C.

NUTRITION

The Recommended Dietary Allowance (RDA) for Vitamin C is 90 mg/day for adult males and 75 mg/day for adult females. The maximum dose is 2,000 mg/day for adults (Bellows, et al., 2012).

ALLERGIES: There are no allergen ingredients in any standard vitamin formulation.

USE FROM STORAGE

Once opened, use vitamins from that container in a few weeks or months. If not needed, reseal vitamins in a manner to preclude oxygen, light, and moisture.

SPICES & SEASONINGS

INTRODUCTION

The addition of spices and seasonings to a long-term food storage program is to enhance palatability and edibility of food storage commodities. These ingredients added to cooking and baking allow us the option of variety and keeps food from being dull and mundane.

Spices are dried seeds, fruit, roots, or bark of plants that are used for flavoring or coloring foods. Herbs are considered leafy parts of plants used for the same purpose (What's Cooking, n.d.). Most spices and herbs contain essential oils that are responsible for the fantastic flavors and aromas they provide. Spices are considered a comfort food with respect to an emergency food supply. They are certainly not a priority, but they can add needed flavors and colors to foods during a long-term emergency replicating the foods cooked on a daily basis.

Two of the most basic seasonings are salt and pepper. Salt is not only used to enhance flavor, but in the case of yeast products, a necessary ingredient to help in proper dough formation.

QUALITY & PURCHASE

Purchase plain iodized salt for long-term storage. Spices and herbs are available in several forms: fresh, whole dried, or dried and ground. Only dried spices are used in emergency food storage. Purchase commercial grade spice at the grocery store. Keep in mind that spices on sale are often already old. Some spices can be stored in oil, but these products should be commercially purchased or be dried spices or herbs added to oils. Fresh spices or herbs added to oils may be a risk for botulism. Spices or herbs can be purchased as single varieties

or blends. Generally screw-cap containers are better than flip tops because they have a tighter seal (Spice Barn, 2009). Exotic seasonings are available at most international markets or can be ordered online.

PACKAGING

The majority of the active components of spices and herbs are plant oils. And as oils, they can oxidize to lose flavor and color. Thus, spices and herbs should be stored in air tight containers, such as jars or Mylar®™-type foil bags. Often the entire spice container can be sealed in jars or foil lined bags. Oxygen absorbers should be used to remove oxygen and prevent oxidation.

STORAGE CONDITIONS & SHELF LIFE

The best place to store spices or herbs is the freezer. Frozen spices or herbs will last considerably longer than those cold or at room temperature provided they are packaged to prevent moisture intrusion. Storing spices or herbs in a hot place will significantly shorten their quality shelf life. Expect to reduce shelf life by at least 50 percent in hot environments (e.g., garages or attics). Whole spices store best. Both ground spices and herbs

(whole or ground) have a much shorter shelf life. Ground spices are exposed to air and tend to lose their quality much faster than the whole variety. When possible, whole, intact seasoning should be purchased and crushed just prior to using. This is easily done with a mortar and pestle or everyday coffee grinder. Ground spices and herbs should be checked for freshness every year, at least once. If there is no apparent aroma then the seasoning should be replaced (Spice Barn, 2009).

Iodized salt and baking powder have an indefinite shelf life when kept free of moisture and contamination. Salt can absorb odors from the storage area, even through the packaging. Salt can be poured into a canning jar and sealed with oxygen absorbers.

NUTRITION

Table salt and seasoning salts will obviously contribute sodium to the diet.

ALLERGIES: Spices offer little nutritive value as a food source and allergies are generally rare. However, if they do occur they are usually fairly mild. Spices that cause the most reactions are mustard, coriander, caraway, fennel, paprika, and saffron. Less frequently do people react to onions, garlic, and chives (Foods Standards Agency, n.d.).
The U.S. Food and Drug Administration does not regulate spices, meaning they often are not noted on food labels, making spices possibly the most difficult allergen to identify or avoid. According to rough estimates, spice allergy is responsible for 2 percent of food allergies. However it is under-diagnosed, particularly due to the lack of reliable allergy skin tests or blood tests (ACAAI, 2012).

USE FROM STORAGE

Stored spices should be used exactly the same as spice for regular meals. If stored for long periods some of the potency may have diminished and adding more of that spice may compensate. Once opened and exposed to air, use the spice quickly within 1 to 4 months.

PROCESSES FOR HIGHER QUALITY STORED FOODS

IN THIS SECTION

INSECT TREATMENTS

INTRODUCTION

Indian meal moth, flour beetles, saw-toothed grain beetles and carpet beetles are just some of the insects that can find their way into food storage. There is nothing like the surprise of opening stored wheat to find either an active infestation of weevils or the results of a past infestation. So the big question is what can be done? The first and most important factor is to purchase high quality supplies that are not already infested with visible insects or their larvae. The second layer of defense is to choose one of the methods below.

OXYGEN ABSORBERS OR VACUUM SEALING (RECOMMENDED)

Some believe that oxygen absorbers are the easiest and most effective method for destroying insects in stored foods (Thompson, 2009). Insects require oxygen to survive, so removing that oxygen is an effective insect prevention measure. The oxygen content must be lowered to below 1 percent and held it there for at least 12 days to kill insects in all stages (Thompson, 2009). The same level of oxygen absorber packets for removal of oxygen is recommended for simultaneous destruction of insects. Basically, 100 cc packets will work for quarts and pint containers, 300 cc packets for gallon containers, and 500 cc packets for 5 gallon containers.

DRY ICE (RECOMMENDED)

Dry ice is frozen CO2. Treatment with dry ice may improve storage life of the grain, but it is not the most effective fumigant for controlling pests in stored grain. The main obstacle is ensuring that the food container is filled to 99 percent CO2 or more. At this level, all insects in all stages do not survive. If the percentage of CO2 is lower, the effectiveness of the treatment is reduced. A single treatment with dry ice may be sufficient for long-term storage. Annual dry ice treatments are not necessary unless an infestation is found in the stored grain.

HEATING

To control insects by heating, preheat oven to 130° F, place grain in a pan and heat for 30 minutes. Grain may also be placed in the microwave and heated on high for 10 minutes. Heating in the oven and the microwave at these settings will both prevent germination (Glogoza, 2005). Heating may work for some dried foods, but others may be changed organoleptically.

FREEZING (RECOMMENDED)

To control insects by freezing, 1-15 pounds of grain should be placed in a medium to heavy plastic bag or double bagged and stored in a freezer for 2 to 3 days. Eggs of insect pests, if present, will not be affected by freezing. Warm grain for 24 hours to allow some eggs to hatch. Repeat freezing cycle. Multiple freeze-thaw cycles may be required.

DIATOMACEOUS EARTH (DE) (NOT RECOMMENDED)

The use of diatomaceous earth (DE) as an insecticide is a "commercial" alternative to traditional chemical insecticides. DE is of natural origin, leaves minimal residues on the product, and has low mammalian toxicity. DE "inactivates" the waterproof lipids of insects causing them to die through desiccation. While overall, DE's work well as an insecticide, specific DE formulations must be tested for activity in each product and against each insect species. In addition, while DE is not a chemical hazard, it is an inhalation hazard. Thus, the nature of the silica powder in DE determines the risk. This makes home insecticidal use impractical and potentially harmful (Subramanyam, 2000).

GARLIC (NOT RECOMMENDED)

Garlic has been studied as a method of insect control. Studies showed some success, but the insect destruction was not complete (Thompson, 2009). Garlic would naturally add flavor and odor to dried foods. For that reason it is not recommended.

BAY LEAVES, CHEWING GUM (MINT FLAVORED OR OTHERWISE), 10-PENNY NAILS, OR SALT (NOT RECOMMENDED)

These treatments are considered old wives tales and there is no research-based evidence that they work.

OXYGEN REMOVAL

INTRODUCTION

Oxygen is vital to life, but it can be quite destructive to some foods, especially over time. This reaction in foods is called oxidation. In fats or oils, oxidation leads to rancidity. In other foods, oxidation destroys natural color (think browning of fresh cut apples). Nature protects many susceptible foods by providing a skin or peel. However, once we start to process these foods we often remove their protections. Normal air is approximately 21 percent oxygen or O2. So storage of foods in air susceptible to oxidation results in poor quality storage over time. Oxygen removal from food storage containers is beneficial in several ways. It prevents food deterioration from oxidation, prevents growth of some microorganisms, and minimizes insects (Charles et al., 2006). When oxygen levels are maintained less than 1 percent, weevils, moths, and flour beetles are eliminated (Broderick et al., 2010). There are several methods to remove oxygen from dry food packages.

VACUUM PACKAGING

Vacuum packaging is used to first remove air from a package by a vacuum and then seal the bag before any air can re-enter. Generally, the longer the food storage shelf life, the greater the vacuum needed. No credible research could be found related to vacuum packaging machines and food storage. Vacuum food savers are usually priced in relation to their ability to create a better vacuum. Models costing less than $100 will suffice for shorter term food storage (1-2 years) and models costing $300-$1500 may be needed to remove enough oxygen for quality storage over 5-30 years.

Be aware that vacuum sealing high moisture foods and subsequent storage at room temperature can lead to deadly foodborne illnesses like botulism. Vacuum packaging for emergency storage should be confined to dried foods with no moisture or only small residual moisture (less than 10 percent).

MODIFIED ATMOSPHERE PACKAGING

This is a more complicated method of vacuum packaging where a replacement gas is added after vacuum removal of air. The replacement gas can be any mixture of nitrogen or carbon dioxide. Since this method requires specialized equipment not typically available to the consumer, it is not further discussed here. Like vacuum packaging, this method should only be used for completely dry foods for emergency food supplies.

OXYGEN ABSORBERS/SCAVENGERS

Oxygen absorbers are packages of iron powder or filings. The iron combines with residual moisture and oxygen in the food package to cause rusting or oxidation of the iron (Thompson, 2009). In this event, the oxygen is bound to the iron and can

no longer oxidize foods. With the use of oxygen absorbers, oxygen is removed throughout the product and package being stored. Oxygen absorbers can reduce the levels of oxygen in packaging to less than 0.01 percent. However, this low oxygen level can only be maintained in packaging specifically designed to prevent the transfer of oxygen across it. Examples are metal cans or Mylar®-style metal foil-plastic bags.

Oxygen absorbers are not edible (Korn, 2011). In addition to iron, most will contain some activated charcoal and salt. All of the ingredients are encased in a paper wrapper that can be placed in contact with foods.

Oxygen absorber packets are made for different moisture levels of foods. Select one made specifically for use in dried foods (assuming emergency food storage is mostly dried foods). Once purchased, store them unopened in their original package. Once opened they will begin absorbing oxygen in 20 minutes and quickly lose effectiveness and may be spent in approximately 5 hours (Thompson, 2009).

Packets usually come in cubic centimeter (cc) sizes of 100 cc, 300 cc, or 500 cc. These are meant to absorb oxygen in that number of cubic centimeters. Typically one 100 cc packet is used for pint or quart jars and small foil bags of the same size. One gallon foil-lined bags or No. 10 cans may need the 300 cc size. Five gallon buckets will need 500 cc. One 500 cc pack or 5 – 100 cc packs will work (Andrade et al., 2007). Keep in mind that plastic buckets will permit oxygen to penetrate over time (Thompson, 2009). So, oxygen absorbers will work to kill insects, but over time will not prevent food oxidation. Oxygen absorbers cannot be reused.

DRY ICE

Dry ice is frozen carbon dioxide. It is an economical method of removing oxygen for home stored foods. It may be used for grains, legume, powdered milk, etc. It is also used as an insect treatment. Place the dry ice in the bottom of the food storage container. Use 4 oz. (1/4 lb) of dry ice per 5 gallon bucket. Use dry ice that is not covered in frost as that adds moisture to the process. Put the lid loosely on the container, and it will take about 4 to 6 hours for the dry ice to sublimate the oxygen, then seal the lid completely. This process will prevent bugs or bacteria from growing. Use caution in handling dry ice.

HAND WARMERS

At least a few people are recommending hand warmers for oxygen absorption. They theorize that the ingredients are the same. However, this is akin to using a toilet plunger for a baseball bat. They both are wood. Yes, it will "technically" work somewhat, but it may not work well. And, the product is simply not made for that use.

MISCELLANEOUS EQUIPMENT

IN THIS SECTION

GRAIN MILLS

INTRODUCTION

Grains are excellent food for storage.They provide many essential nutrients and are a staple of a balanced diet. Grain flour is used in preparing bread and countless other baked goods. There are a number of available types of grains that can be purchased and stored including wheat, oats, rye, and more. All of these grains need to be milled into flour before they can be used for human consumption. Milled grains can be stored as flour, but their shelf life is limited to under a year. As milled grains are stored, they are subject to loss of nutrient content and quality due to oxidation. This loss of quality will not occur if grains are stored unmilled in their whole kernal. Whole kernal grains can last for up to 25 years in a proper food storage container. A very long shelf life and maintained quality make whole kernal grains ideal food storage items. However, it does require the purchase of a personal grain mill.

QUALITY & PURCHASE

There are numerous types of personal grain mills available. Mainly, they are divided into two categories, electric and hand-powered. This should be taken into account since power may not be available in an emergency. Not only will hand-powered mills work without power, but they are also considerably more affordable. Consumers could easily spend much more on a grain mill than is necessary for their needs, but a reliable mill will be needed to provide adequate results. Therefore, consumers should be advised to shop around and find a mill that fits their needs and budget. Often, personal grain mills have additional attachments that can be purchased to aid in preparing other types of foods. These should be considered if the attachment would provide aid in using other food storage items. Reasonable judgment is advised, as many of these

attachments are unnecessary, especially in an emergency. There are several types of grinders within the mills that are available. Mainly, they determine how fine or coarse the flour product will be. Many health food and nutrition-based grocery stores carry grain mills. There are also available through many emergency preparedness stores and online suppliers.

USE FROM STORAGE

As mentioned earlier, grains store much better unmilled. Therefore, grain from storage should be milled on an "as needed" basis. A person using a basic hand-powered grain mill has the ability of grinding at the rate of about 1/2 cup per minute. This is enough flour to make a few loaves of bread in less than half an hour. Once purchased, it would be wise to become familiar with the grain mill before placing it in storage. It should be used before an emergency situation requires it.

CARE & MAINTENANCE

Care instructions provided by the manufacturer should be followed. Many grain mills cannot be washed without causing damage to the mill. It is important to become familar with the proper care and handling of the machine before use.

HEAT (IMPULSE) SEALERS

INTRODUCTION

Heat sealing is accomplished by applying pressure and heat to melt films and bond them together, providing a safe environment for the food contents inside (Kun-xiu & Sheng-hai, 2013).

When working with foil pouches, heat impulse sealers should be used. One theory of heat sealing is to use an iron to seal a package instead of a heat impulse sealer. However, using an iron will not seal the package properly, especially for powdered products (Korn, 2013).

Heat impulse sealers are available at most home storage centers.

CRITICAL FACTORS IN SEALING

Critical factors in heat sealing include the seal bar temperature, the pressure put on the seal by the sealing bars, and the time seal bar pressure is applied on the seal (FDA, 2009). Increasing seal pressure above the amount required will not improve the sealing and may result in thinning of films at the seal (Baer et al., 1998). Instructions provided with the sealing unit should be followed.

It is important to make sure that the seal area is not contaminated with food, grease, moisture, or some other contaminant that may weaken or prevent the seal. The sealing surface should be smooth, parallel, and wrinkle and contaminant free.

TESTING SEALS

After the process of sealing, look over seams to make sure they are adequate and don't have burn spots. If seams are burned, decrease the sealing setting by one quarter step. You should not be able to pull the seam apart. If seam can be pulled apart, the seam area of the machine may need to be cleaned or the pouch may be too full. If needed, the sealing setting may be increased by one quarter step, then reseal the pouch. Pressing on the package should not cause leaks (Kropf, 2004).

METAL CAN SEALERS

INTRODUCTION

How does the metal can sealer work? Metal can sealers are used to attach the can lid to the can body through a double seam. The can sealer first connects the lid edge, sealing material, and the can body by curling them together. This first step needs to be done correctly because it cannot be corrected on the second step. The second step presses the layers of metal tightly together, resulting in a flattened and smoothed seam. Both ends of the can should be flat or slightly concave at the end of the process. Always follow instructions that come with the metal can sealer. This process makes the container air tight and protects the food items inside it from the entry of microorganisms during and after processing (Long, 2009).

Can size: The size of the can will determine the chuck size, position of seaming rollers, number, and size of spacers used with the turntable spring and turntable, and the turntable extension (University of Alaska, 2007).

BEFORE SEALING

Before sealing, check all cans, lids and sealing material. Cans or lids that are bent or dented are unacceptable for use. Make sure that the sealing material goes all the way around the lid sealing edge. Do not wash, boil, or heat lids before use. The sealing material is different on cans than it is on jars. Cans may be rinsed or wiped with a damp cloth if they are dusty (Long, 2009).

The type of food item being canned determines the method of processing. For instance, when canning meats, there are specific guidelines that need to be followed as far as processing before and after sealing. The University of Alaska Fairbanks: Cooperative Extension Service gives instructions on how to can meat and fish in cans at this website: **http://www.uaf.edu/ces/preservingalaskasbounty/**

Defects: Defects are possible during the sealing process. They include: droop, vee, sharp seam, cut seam, incomplete seam, and false seam. Cans with defects should not be used because the defects can prevent the seam from being airtight, can promote spoilage, and may allow the botulism bacteria through the defective seam. Running the can through the sealer again will not fix the defects. If the can is defective, the contents must be put into a new can and reprocessed (Long, 2009).

Problems	Solutions
Turntable pressure too high	Decrease pressure - check number of spacers for can size
First seam roller operation too loose	Tighten
Food trapped in seam	Clean can edge before seaming
Defective cans	Inspect cans before use
First seam roller worn out	Replace seam roller
First/second seam roller operation too tight	Loosen
Worn seam rollers and/or chuck	Replace rollers and/or chuck
Seam rollers not rotating freely	Clean, oil, or repair seam rollers so they rotate freely
Oil or grease on seaming chuck or on turntable	Clean seaming chuck and/or turntable
Can overfilled	Check fill of can

CHECKING THE CAN SEALER

To make sure that it is working properly, the metal can sealer can be tested. First put a small amount of cold water in a can and seal it. Then pick up the can with tongs, with the newly sealed end up, and submerge the can in boiling water for 1-2 minutes. If there are air bubbles around the seam, it is not tight enough. To adjust the sealer, follow the manufacturer's instruction (Hughes, 2000).

WARNING

Cans that are leaking, bulging, badly dented, have a foul odor, or spurt liquid when opened should NEVER be used. These are all signs of botulism. Consuming even an extremely small amount of the botulism toxin can be deadly (FSIS, 1009).

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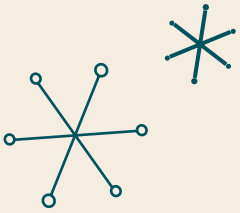

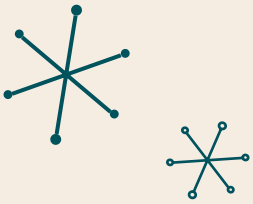

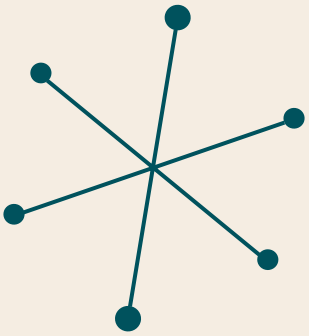

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