

Smoking Fish at Home

Introduction

Producing high quality home-smoked fish is a popular recreational activity and a point of pride for many Alaskans. In earlier times, smoking was a form of food preservation; large amounts of salt and long smoking times were used to help preserve the fish. Now fish is smoked more for flavor and appearance. Today's lightly salted and smoked fish is not a preserved product; the amounts of salt and smoke used are NOT sufficient to prevent bacterial spoilage. Most food poisoning bacteria can and will grow under the conditions normally found in preparation and storage of smoked fish. *Clostridium botulinum*, the bacteria that may cause botulism, is the most harmful of these bacteria.

A safe, home-smoked product requires a good understanding of the procedures and precautions needed to prevent food poisoning. This publication explains why certain procedures must be followed and precautions taken to prepare safe, high-quality smoked fish.

The Smoking Process

Smoking fish usually includes five steps. These are:

- Product preparation
- Salting or brining
- Equilibration and drying
- Smoking and cooking (hot or cold smoke)
- Product packaging and storage

Careful handling, as described in this publication, will help minimize the potential for bacterial spoilage and food poisoning and yield a high quality finished product.

Product Preparation

Almost any fish can be smoked. Fatty fish, such as salmon and black cod, can be brined and smoked

much more easily than lean fish. Low-fat fish, such as grayling and halibut, absorb salt quickly, and it is easy to get the flesh too salty.

Only high-quality fresh or frozen fish should be used for smoking. Using poor-quality, freezer-burned fish will produce a poor smoked product. Smoking will not hide poor quality; it will call attention to the problem.

When preparing fish for smoking, it is important to keep the preparation area clean and sanitary. Keeping the work area, cutting boards, knives and hands clean will help prevent bacterial contamination. Do not, under any circumstances, place your finished smoked fish on unclean, unsanitized surfaces that have previously held raw fish. This could result in cross-contamination; spoilage bacteria could transfer from the raw to the finished product.

Rinse and clean all fish carefully to remove slime, dirt and blood and to help remove harmful bacteria. Then fillet or split the fish, leaving the skin on the fillet. Cut the fillet into uniformly sized pieces so that no parts will get oversalted. Pieces should not be more than one inch thick. Pieces smaller than 1 inch thick may spoil during the smoking process.

During preparation, fish should be kept as cool as possible. This will help reduce bacterial growth and spoilage. The ideal temperature for holding fish is below 38°F. Home refrigerators are often 40°F or higher. Check the refrigerator temperature with an appliance thermometer and adjust controls as needed.

Fresh fish frequently contain parasites. Tapeworms and nematodes can survive low-salt brining and low-temperature smoking methods and may cause serious health problems. These parasites can be

destroyed by freezing the raw product at a temperature of 0°F for two weeks or longer, **before** salting and smoking. When freezing the product in a home freezer, it may take several days to reach 0°F throughout the entire fish; *the more food you put in the freezer at one time, and the thicker the pieces of food are, the longer it will take to freeze the food.*

(If you have several fish to freeze at one time, it would be a good idea to borrow or rent additional freezer space to be sure the fish can freeze within a reasonable time.)

For hot-smoked products (see section on smoking) the internal temperature of the fish is raised to at least 160°F for bacterial reduction. Since this exceeds the 150°F required to kill parasites, only fish intended for a cold-smoke process must be frozen prior to processing.

Salting

The second step in the smoking process is salting the fish. Salting was once the preservation step in smoking. High levels of salt inhibited bacterial growth and made the product safe. With modern, lower salt methods, salt reduces bacteria incompletely; however, it contributes desirable texture and flavor characteristics.

Salting can be accomplished using either a strong salt solution (brine) or dry salt. For most recipes, brining gives a more uniform salting and is easier to prepare and use. Dry salting requires considerable experience before consistent results are obtained.

Brines can be prepared by dissolving salt in fresh water. Use only kosher salt, vacuum-dried salt, dairy salt, pickling and canning salt, or flake salt for brines. These are pure salts. Avoid rock salt, sea salt and iodized salt because these contain impurities and additives that can cause bitterness and "off" flavors. Curing salts should also be avoided since they contain nitrites. It is difficult to get an even distribution of nitrite throughout the fish under home conditions.

Any strength brine may be prepared. A recommended brine can be made by dissolving 1½ pounds of salt per gallon of water. Once the brine

is made it should be chilled to 38°F or lower before use. Using a well-chilled brine will help reduce bacterial growth and increase salt uptake into the fish. Place the fish in the brine for 20 minutes to 3 hours depending on the desired taste. Weaker brines (using less than 1½ pounds of salt per gallon) can be used with correspondingly longer soak times.

If fish is brined for an hour or longer, it should be "freshened" by soaking it in fresh water to remove the excess brine. This usually takes 30 to 60 minutes for most products. For a lightly salted product (brining times less than 1 hour), a fresh-water rinse is sufficient to remove excess brine.

The brine-to-fish ratio should be 3 parts brine to 1 part fish. For example, 10 pounds of fish will require 30 pounds of brine (approximately 4 gallons; 1 gallon of brine weighs about 8 pounds).

Do not reuse brine. Fresh brine should be made of each batch of fish.

Drying

Once the fish has been brined and rinsed, it is usually dried before smoking. Drying accomplishes two things: (1) it allows the salt to penetrate and to become evenly distributed throughout the flesh of the fish (equilibration), and (2) the surface of the fish dries to form a "pellicle" or tough shiny coat. The pellicle seals in moisture and makes the appearance of the finished product much better.

Refrigerate the fish during equilibration and initial drying. Keep temperatures below 38°F. Equilibration may require anywhere from 2 to 24 hours depending on fish thickness (6 to 8 hours for a 1-inch-thick fillet).

Additional drying and forming a pellicle requires warmer temperatures and is usually done in the smoker just prior to smoking. Fish is ready for the smoker when its surface becomes tacky and slightly shiny and when the texture is noticeably firmer. Place the fish, skin side down, on lightly oiled smoker racks and place in a warmed (but not hot) smoker. Allow the fish to continue to dry and the pellicle to form in the warm smoker without the addition of any wood chips for between 30

minutes and 3 hours. The time required for the additional drying will depend upon the temperature and air circulation in the smoker and the general humidity level (often high in Southcentral and Southeast Alaska). If possible, avoid the longer times because the potential for bacterial spoilage becomes greater.

Smoking

The fourth step of the process is smoking. There are many recipes for smoking using different times and temperatures, but only two basic methods:

1. “Hot” smoke: the internal product temperature reaches 160°F and higher. A cooked, smoked product such as kippers is produced.
2. “Cold” smoke: the internal product temperature is below 90°F. The resulting product is a raw, smoked fish such as lox or Nova Scotia-style salmon.

For most people, hot smoking is the most popular product and easiest to produce in home smokers.

Also, the temperatures recommended for hot smoking are high enough to kill most bacteria. Cold smoke temperatures are not hot enough to kill bacteria and actually may promote growth of bacteria.

Recommendations for each smoking method:

Hot Smoking

- Heat the fish to 160°F internal temperature (use a thermometer) for at least 30 minutes at some time during the smoking cycle, preferably toward the end. This temperature will kill most food spoilage bacteria, and combined with proper refrigeration will ensure a safe product. A typical fish smoking cycle (figure 1) should bring the internal temperature of the fish to 160°F within 6 to 8 hours after placing it in the smoker.
- Use a standard meat thermometer to monitor internal temperature. Insert the thermometer into the thickest part of the fish.
- It is best to wait 3 to 5 hours before raising the internal temperature of the fish to 160°F. This

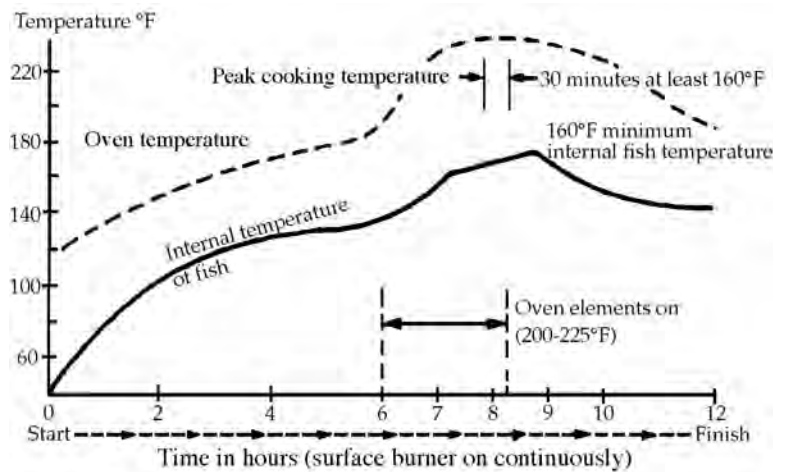


Figure 1. Typical internal fish temperature during smoking cycle.

Source: Kenneth S. Hilderbrand, Jr., *Smoking Fish at Home Safely*, Pacific Northwest Extension publication PNW 238. Reprinted September 1996

will prevent curd formation and “exploded” pieces that occur when the temperatures are elevated too quickly.

- If the smoker does not heat hot enough to produce an internal temperature of 160°F in the fish, the smoked fish can be transferred to a home oven set at 300°F for a final heat treatment. Bring internal fish temperature to 160°F and bake for at least 30 minutes. Adjust the oven temperature as needed throughout this baking period to maintain the 160°F internal temperature. Be sure that hands, utensils and work surfaces are clean when transferring fish from smoker to oven to avoid cross-contamination.
- Depending on the desired finished product, smoking should take anywhere from 6 to 15 hours. Shorter heating and smoking times will result in moister finished products.

Cold Smoking

If cold-smoked fish will not be cooked prior to eating, the freezing step (page 2) is necessary to destroy harmful parasites that may be present in uncooked fish.

- Temperature control is very critical. Never allow the internal product temperature to exceed 90°F. At 95°F, the fish will start to cook.

- It is difficult to cold smoke in areas of high humidity. When relative humidity cannot be reduced below 75 percent at air temperatures below 85°F, then cold smoking is not possible.
- Depending on the desired finished product, smoking will take anywhere from 16 hours to 7 days.

Caution: The entire cold smoking process takes place in the temperature “danger zone” (40°F to 140°F). Therefore, this product could spoil or become unsafe to eat before it is fully smoked.

Product Storage

The final and most important step in producing smoked fish is product storage. Most smoked products have had no preservation step. There is not enough salt, smoke or heat to preserve the product. The potential for bacterial spoilage and botulism exists.

After the fish has been smoked, allow it to cool to room temperature (this will prevent condensation) and then do one of the following:

1. Wrap and refrigerate below 38°F until consumed. Use a good plastic wrap and/or aluminum foil. Lightly salted and smoked products can last for 10 to 14 days in the refrigerator. (Again, make sure that your refrigerator can maintain proper temperatures.)
2. Wrap and freeze. Use a good freezer wrap and aluminum foil or home vacuum sealer packaging to protect the product in the freezer. Prop-

erly protected smoked salmon will last for 2 to 3 months.

You **MUST** refrigerate or freeze the finished product in order to keep the smoked fish **SAFE**. Even vacuum-packaged smoked fish **MUST** be kept refrigerated or frozen. **NEVER** leave smoked fish at room temperatures. Please refer to FNH-00221, *Storing and Mailing Vacuum Packaged Fish*.

Brine Recipes

Heavy salt brine: 2½ pounds (4½ cups) of salt per gallon of water.

Medium salt brine: 1½ pounds (2½ cups) of salt per gallon of water.

Slowly pour salt into water stirring constantly. Chill before using. Sugars and pickling spices can also be added to give extra flavors to the finished product. Vary the ingredients and proportions to suit your taste:

- *Heavy salt brine*, add 1½ cups white or brown sugar per gallon of water.
- *Medium salt brine*, add 1 cup white or brown sugar per gallon of water.

Spices: amounts per gallon of water

- Bay leaf ----- 50 leaves, crushed
- Pepper ----- 8 teaspoons
- Mace ----- 2 tablespoons
- Allspice ----- 7 teaspoons
- Cloves ----- 2 tablespoons
- Juniper berries ----- 2 tablespoons, crushed

Smoked fish also may be canned. Please refer to FNH-00223, "Home Canning Smoked Fish and Home Smoking Fish For Canning," for directions.

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