

Smoking Fish at Home—Safely

A PACIFIC NORTHWEST EXTENSION PUBLICATION

WASHINGTON STATE UNIVERSITY • OREGON STATE UNIVERSITY • UNIVERSITY OF IDAHO

Three common factors in all hot fish-smoking recipes are salt, smoke, and heat. This guide explains the basic techniques for preparing delicious hot-smoked fish safely. It also recommends refrigerated storage for all smoked fish.

Note that the process described here applies to fish smoked using heat and is distinct from cold-smoked fish. (Cold-smoked fish is cured and smoked at temperatures below a range of 80–90°F during the smoking process, which means it is unpasteurized and therefore must be handled carefully to avoid illness from harmful bacteria.)

Smoked fish is good, but...

Fish smoked without proper salting and cooking can cause foodborne illness—it can even be lethal. Many dangerous bacteria can and will grow under the conditions normally found in the preparation and storage of smoked fish. *Clostridium botulinum* is the most notorious of these bacteria, but there are other harmful ones as well.

Because it is not easy for a producer at home to determine the final salt content of fish, the following parameters for adequate cooking while the fish is being smoked and refrigeration after the fish is smoked are the only ways a consumer can ensure a product will not support the growth of harmful bacteria:

- You must heat the fish until the *internal* temperature reaches 150°F (preferably 160°F) and is maintained at this temperature for at least 30 minutes. (See “Time-temperature requirements,” page 4.)
- You must salt or brine fish long enough to ensure that adequate salt is present throughout the smoked fish (at least 3.5% water phase salt; see related section on page 4).
- If storing, you must keep smoked fish under refrigeration at 38°F or less.

Higher fat fish absorb smoke faster and have better texture after smoking than lower fat fish. On the West Coast, some of the ideal species for smoking are shad, sturgeon, smelt, herring, steelhead, salmon, mackerel, sablefish, and tuna.

You can smoke any fish without worrying about foodborne illness if you observe the basic principles explained below for preparation, salting, smoking, cooking, and storage.

Preparation

Different species of fish require different preparation techniques. Salmon are usually prepared by removing the backbone and splitting. Bottom fish are filleted. Small fish such as herring and smelt should be headed and gutted before brining. (Columbia River smelt are traditionally smoked whole because they have stopped feeding by the time they are harvested.)

Certain principles apply in all cases. First, use good quality fish. Smoking will not improve fish quality; in fact, it may cover up certain conditions that could create food safety problems later.

Thaw frozen fish in cool ambient air or clean fresh water.

Clean all fish thoroughly to remove blood, slime, and harmful bacteria. Keep fish as cool as possible at all times, but do not refreeze. When you cut fish for smoking, remember that pieces of uniform size and thickness will absorb salt in a similar way, reducing the chance that some pieces of fish will be either under- or over-salted. Do not let fish sit longer than 2 hours at room temperature after cleaning and before smoking.

Salting

Salt preserves smoked fish by reducing the moisture content. However, without chemical analysis, it is hard to be certain that a fish has absorbed enough salt. That is why proper cooking and refrigerated storage are essential for safety. The following rules of thumb are useful to approximate the proper salt level for smoked fish.

Salt the fish before smoking in a strong salt solution (brine). Salting fish in a brine that is 1 part table salt (non-iodized and with no anticaking agent) to 7 parts water by volume for 1 hour will work in most cases. For instance, 1 cup of salt with 7 cups of water will salt 2–3 pounds of fish. (This proportion will read approximately 60° SAL on the scale of a salometer. By weight, this formulation would be 1.57 pounds of salt per gallon of water.) A salometer is an instrument that can be purchased from a scientific supply store or a salt manufacturer for measuring the salt concentration of a brine.

A gutted herring requires about 30 minutes brine time in a refrigerator; large or oily fish (e.g., 2–3 inch chunks or steaks from a 30-pound salmon) require about 2 hours. Decrease the brine time for low fat and skinned fish. When experimenting with brining time, start with 15 minutes per half inch of fish thickness. Fish pieces should not overlap when they are being brined or salt uptake will not be uniform. A smoked fish with a definite—but not unpleasantly high—salt flavor probably has absorbed enough salt. Dry salting techniques are acceptable, and the same general rules apply. However, using a brining solution typically yields a more uniform salt concentration.

Many recipes call for brines with a lower salt concentration than the 1 part table salt to 7 parts water noted above—but for 18–24 hours. These extended periods offer more opportunity for bacterial growth and possible spoilage later, and probably increase the mess you have to clean up later. For more information on making salt brines, refer to the Oregon Sea Grant publication ORESU-H-99-002, which is available at <http://seagrant.oregonstate.edu/sgpubs/onlinepubs/h99002.pdf>.

Once the brining period is complete, rinse the fish surface and allow it to air dry meat side up on a greased rack in a cool place until a pellicle forms (i.e., at least 1 hour) before smoking. A pellicle is a shiny, slightly tacky skin that will form on the meat surface of your fish. If proper drying conditions are not available (cool, dry air), place the fish in a smoker with low heat (80–90°F), no smoke, with the doors to the smoker open so the pellicle can form. Use a low, clean flame if you have a wood heat source. A pellicle will 1) give the smoke a chance to deposit evenly during smoking and 2) help prevent surface spoilage during smoking.

Smoking and cooking

Hot-smoked fish require 2 sequential processes: smoking

followed by cooking. The length of smoking time depends on the flavor and moisture level you want. Smoking first will result in a better-tasting product due to less of a baked fish flavor and curd formation caused by juices boiling out of the fish. Some oily fish (such as sablefish) may never appear to dry out the way salmon or tuna do, but they will still be properly smoked if this procedure is followed.

Smoke your fish for up to 2 hours at around 90°F in a smoker, and then increase the heat until the fish reaches a temperature of at least 150°F (preferably 160°F) and cook for at least 30 minutes (Fig. 1). *It is important to measure product temperature* because of variations in how warm air circulates inside smokers. A long-stemmed thermometer inserted into the thickest piece of fish through a hole in the smoker wall will allow temperature monitoring without opening the door. Ensuring that the thickest section of meat is at a high enough temperature should be sufficient for the rest of the fish.

If the air temperature in your smoker cannot reach 200–225°F, you'll need to cook the fish in your kitchen oven within 2 hours after the smoking process. Waiting longer presents a danger of spoilage from bacterial growth. As in a smoker, the core temperature in the thickest piece of the fish must be maintained at a minimum 150°F for 30 min.

Remember: Smoke itself is not an effective preservative under most conditions.

Figure 2 shows the features to look for in a smoker and their general arrangement:

- an independent source of heat for the pot of wood chips or logs

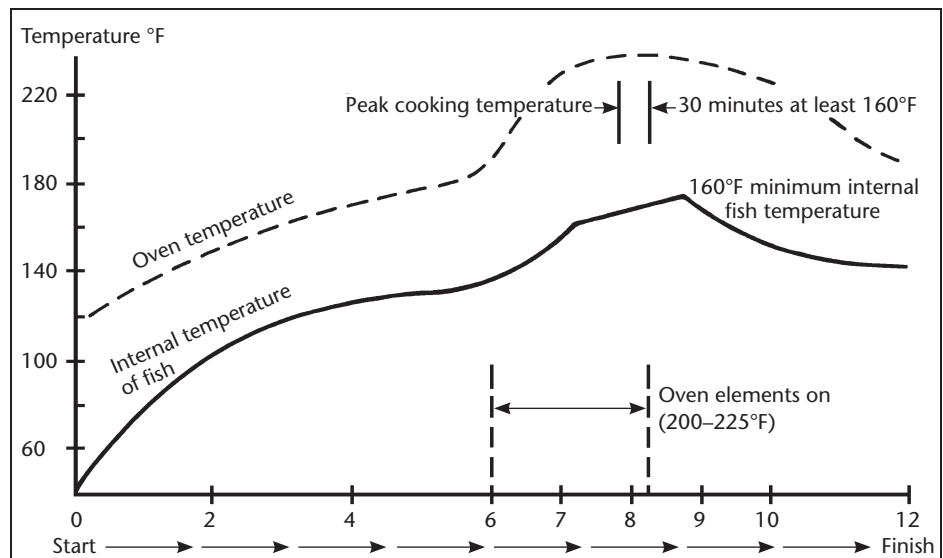


Figure 1. Typical internal fish temperature during a smoking cycle.

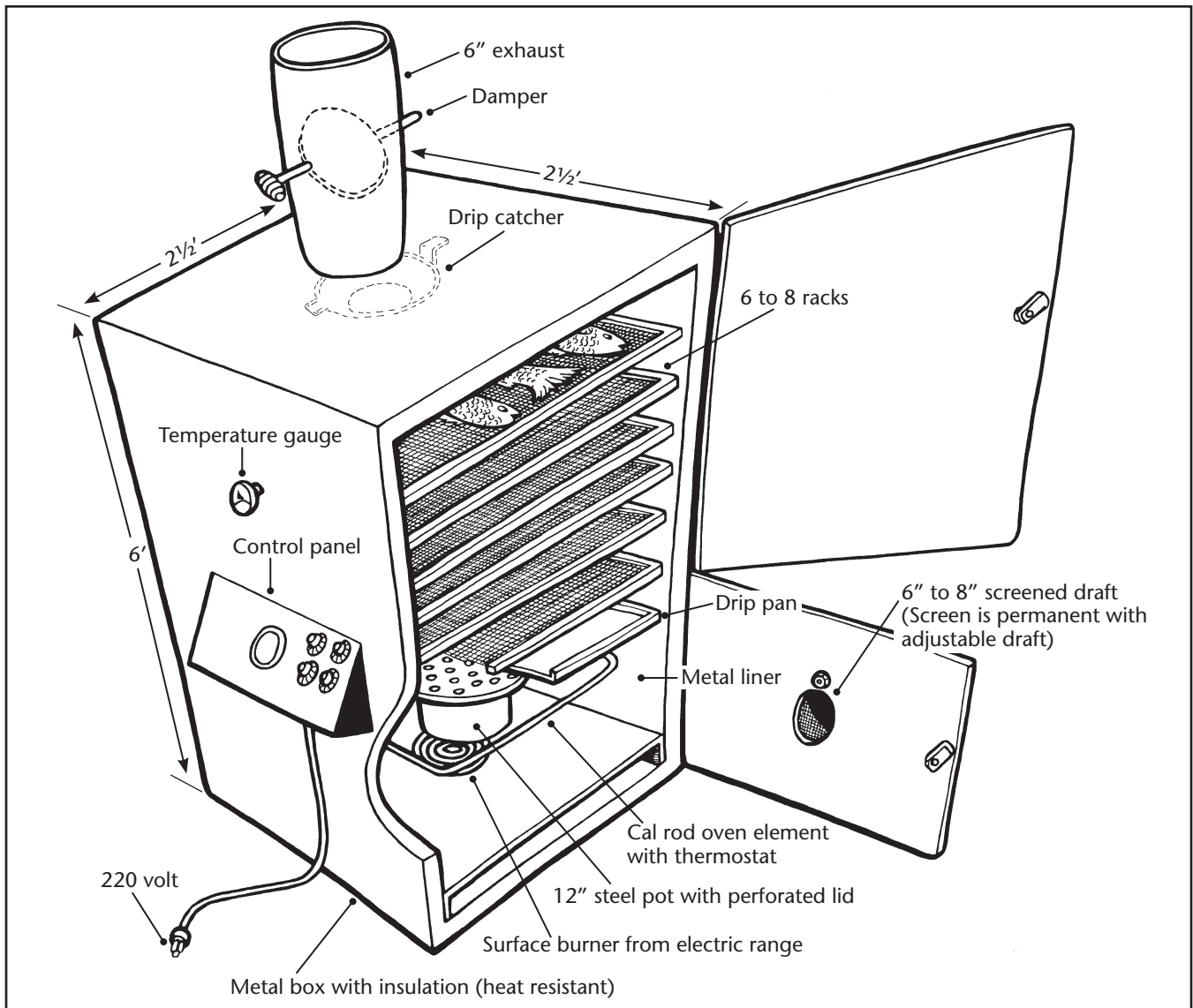


Figure 2. Basic components and layout of a good smoker. (This drawing should not be used as a blueprint for building a smoker.)

- a controllable vent or flue at the top
- a controllable draft at the bottom
- thermostatic control over the oven temperature
- another heat source to raise the temperature in the smoker to 225°F

A common question asked about fish smoking relates to the small metal smokers readily available in most hardware or sporting goods stores. It is difficult to reach temperatures high enough for proper cooking with these units. Such devices should therefore be supplemented with oven cooking to achieve a core temperature for the fish of 150–160°F. A small metal smoker could therefore be used for up to 3 hours to complete the first portion of the process, and then a home oven can safely complete the procedure by heating the fish to an internal temperature of 160°F for 30 minutes.

Use only hardwood for making smoke. Maple, oak, alder, hickory, birch, and fruit woods are all good woods for smoking fish. Wood from conifers leaves an unpleasant taste on the fish. Do not use fir, spruce, pine, or cedar.

Storage

Freeze or refrigerate (preferably at 38°F or less) your smoked fish if you vacuum pack it and do not plan to eat it immediately. *This is essential* if you have any doubt about the salt content or time and temperature process achieved during smoking. If you do not vacuum pack your smoked fish it is important to keep it refrigerated to maintain both safety and the best product quality.

You can retard mold growth on your smoked fish if you package it in a porous material such as cloth or paper toweling. This prevents “sweating,” a process in which moisture moves from the fish to the inside of the bag, causing a wet spot where mold can grow. This can be a problem if you place warm, plastic-wrapped fish in a refrigerator.

If storing longer than 2 weeks, tightly wrap and freeze smoked fish. Properly frozen, fish can hold for up to 1 year. Little quality is lost by freezing smoked fish because of its low moisture content. (For instructions on correct packaging for freezing, see PNW 586, *Home Freezing of Seafood*.)

Vacuum packed	Freeze or refrigerate (38°F or below)
Not vacuum packed	Refrigerate or freeze
Storage longer than 2 weeks	Freeze
Refrigerator temperature above 40°F	Freeze

Liquid smoke and sodium nitrite recipes

While liquid smoke and sodium nitrite are used in some home recipes for flavor, you should not rely on them for product safety. The only safety measure you can rely on is adequate refrigeration—and then only after proper cooking.

Time—temperature requirements

Although regulations for commercial fish smokers may permit a minimum internal fish temperature lower than 160°F for the 30 minutes of cooking, home smokers don’t have the continuous time—temperature recording equipment necessary to ensure proper cooking. Therefore, it is important to maintain these standards.

Similarly, if your home refrigerator cannot reliably maintain a temperature under 40°F, the smoked fish should be kept frozen regardless of whether it

is vacuum packaged. Besides *Clostridium botulinum*, there are other dangerous bacteria that could potentially grow on smoked fish held in a refrigerator that cannot hold a cold enough temperature.

3.5% Water Phase Salt (WPS)

The minimum level of salt recommended by the U.S. Food and Drug Administration for commercial products is 3.5% WPS, which is the percentage of salt in relation to moisture left in it after smoking and cooking. Although most home smokers don’t measure percent WPS, you should keep in mind that a definite level of salt is required for safety and that adequate refrigeration is the only safeguard.

For further information

Most bookstores and sporting goods stores carry a variety of books on smoke cooking that have delicious recipes and clear instructions. These, plus the use of common sense in following the principles outlined in this publication, will ensure safe, pleasing, home-smoked fish.

Related PNW publications

Fish Pickling for Home Use, PNW 183
Canning Seafood, PNW 194
Home Canning Smoked Fish, PNW 450

These and other PNW publications can be obtained from the following cooperating institutions:

Washington State University
 tel. 509-335-2857 (toll free) 1-800-723-1763
<http://pubs.wsu.edu/>

Oregon State University
 (toll free) 1-800-561-6719
<http://extension.oregonstate.edu/catalog>

University of Idaho
 tel. 208-885-7982 fax 208-885-4648
<http://www.extension.uidaho.edu/catalog.asp>

Barbara Rasco, Senior Food Scientist, Washington State University, revised the November 2009 version of this publication in consultation with Carolyn Raab, Extension Foods and Nutrition Specialist, Oregon State University; and Sandra McCurdy, Extension Food Safety Specialist, University of Idaho. Kenneth S. Hilderbrand, Jr., Extension Sea Grant Seafood Technologist Emeritus, Oregon State University, authored the original publication.

Pacific Northwest Extension publications are produced cooperatively by the three Pacific Northwest land-grant universities: Washington State University, Oregon State University, and the University of Idaho. Similar crops, climate, and topography create a natural geographic unit that crosses state lines. Since 1949, the PNW program has published more than 600 titles, preventing duplication of effort, broadening the availability of faculty specialists, and substantially reducing costs for the participating states.

Pacific Northwest Extension publications contain material written and produced for public distribution. You may reprint written material, provided you do not use it to endorse a commercial product. Please reference by title and credit Pacific Northwest Extension publications.

Issued by Washington State University Extension, Oregon State University Extension Service, the University of Idaho Cooperative Extension System, and the U.S. Department of Agriculture in furtherance of the Acts of May 8 and June 30, 1914. Extension programs, activities, materials, and policies comply with federal and state laws and regulations on nondiscrimination regarding race, sex, religion, age, color, creed, or national or ethnic origin; physical, mental, or sensory disability; marital status or sexual orientation; and status as a Vietnam-era or disabled veteran. Washington State University Extension, The Oregon State University Extension Service, and University of Idaho Extension are Equal Opportunity Employers. Evidence of noncompliance may be reported through your local Extension office. Trade names have been used to simplify information; no endorsement is intended. Published July 1983, revised November 2009.