

Smoking Fish at Home — Safely

K.S. Hilderbrand, Jr.

Three common ingredients in all fish-smoking recipes are salt, smoke, and heat. This publication points out that salt and heat are important for safety, and it explains the basic techniques for preparing delicious smoked fish with absolute safety. It also recommends refrigerated storage for all smoked fish.

Note that this publication applies to fish heated during the smoking process. “Coldsmoked” fish (which usually means fish kept below a range of 80 to 90°F) is a different product and is not discussed here.

Smoked fish is good, but...

Fish smoked without proper salting and cooking can cause food poisoning—it can even be lethal. Most food poisoning bacteria can and will grow under the conditions normally found in the preparation and storage of smoked fish. Botulism is, of course, the most harmful of these bacteria.

There are two requirements for the smoking of fish so that it will store safely with refrigeration (38°F):

- You must heat fish to 160°F internal temperature and maintain this temperature at least 30 minutes. (See “Time-temperature requirements,” page 4.)
- You must salt or brine fish long enough to ensure adequate salt is present in the finished product (greater than 3½% water phase salt; see “3½% WPS” on page 4).

Strict attention to both of these requirements is essential, for two reasons:

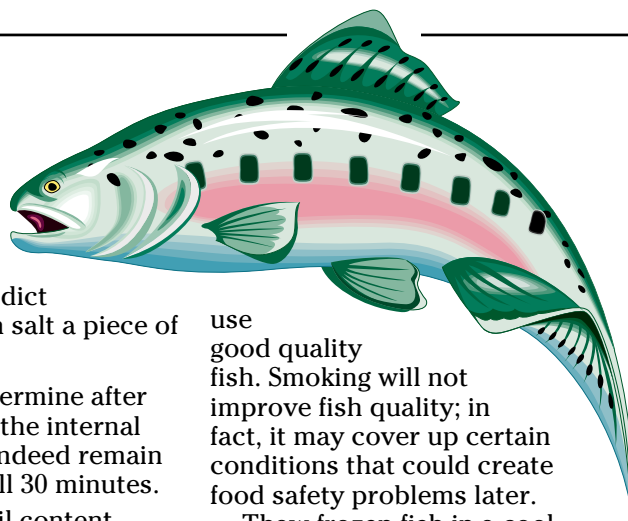
- It’s difficult to predict exactly how much salt a piece of fish will absorb.
- It’s difficult to determine after smoking whether the internal temperature did indeed remain at 160°F for the full 30 minutes.

Fish with a high oil content usually is the best for smoking. It absorbs smoke faster and has better texture. On the West Coast, some of these species are shad, sturgeon, smelt, herring, steelhead, salmon, mackerel, sablefish, and tuna. You can smoke any fish, however, without fear of food poisoning if you observe some basic principles. You’ll find these principles in the fundamental steps of all fish-smoking recipes: preparation, salting, smoking and cooking, and storage.

Preparation

Different species of fish require different preparation techniques. Salmon usually are 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 traditionally have been smoked whole because they have stopped feeding by the time they are harvested.)

In general, however, 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 a cool place or in cool 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 uniformly sized pieces will help achieve more uniform salt absorption without risk of over-salting. Do not let fish sit longer than 1 or 2 hours after cleaning and before smoking.

Salting

Salt is what preserves smoked fish. Products with high moisture content require more salt than “dry” products.

Without chemical analysis, it’s hard to be certain that the fish has absorbed adequate salt. That’s

Kenneth S. Hilderbrand, Jr., Extension Sea Grant seafood technologist emeritus, Oregon State University, in consultation with Extension specialists at the University of Idaho and Washington State University.

why proper cooking and refrigerated storage are essential for absolute safety. However, some rules of thumb are useful to approximate the proper salt level.

Salt the fish before smoking in a strong salt solution (brine). Salting in a brine that is 1 part table salt to 7 parts water by volume for 1 hour will do in most cases. For instance, 1 cup salt with 7 cups water will salt 2 or 3 pounds of fish. (This proportion will read approximately 60° on the salometer scale.)

About 30 minutes should do for a gutted herring. However, large or oily fish will require more time. Two hours for large chunks of a 30-pound salmon is a good starting place for experimenting.

Decrease the time for nonfat fish and for skinned fish. A final product that has a definite, but not unpleasant, salt flavor probably has absorbed enough salt.

Dry salting techniques are acceptable, and the same general rules apply. However, brining should give more uniform salting than dry salting.

Many recipes call for lower salt brine concentrations than the 1 part table salt to 7 parts water formula given above—but for extended periods, 18 to 24 hours. These recipes may be sufficient, but they tend to offer more opportunity for bacterial growth and possible spoilage later. In addition, these procedures prolong the entire process and increase the mess you must clean up later.

Rinse and air dry all fish before smoking. This not only gives smoke a chance to deposit evenly but also helps to prevent surface spoilage during smoking. Smoke will not deposit easily on a wet surface.

If proper drying conditions are not available (cool, dry air), try placing the fish in the smokehouse with low heat (80 to 90°F), no smoke, and doors open. With a wood heat source, use a low, clean flame.

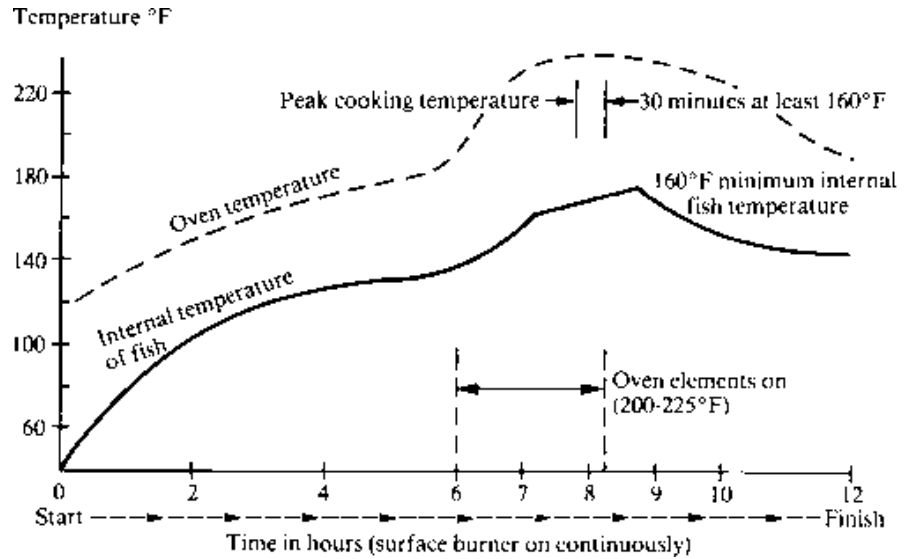


Figure 1.—Typical internal fish temperature during smoking cycle.

Smoking and cooking

Cook the fish at 160°F internal temperature for at least 30 minutes at some time during the smoking “cycle.” This peak cooking temperature probably is the most important part of any fish-smoking recipe—and one that is often forgotten in home smoking.

Because you cannot determine the final salt content (without chemical analysis), proper cooking and adequate refrigeration are the *only* way you can ensure a product safe from botulism.

A typical fish-smoking cycle (see Figure 1) should bring the fish to over 160°F internal temperature within 6 to 8 hours (*internal*—not oven—temperature).

If your smokehouse cannot provide 200 to 225°F oven temperatures, you’ll have to cook the final product in your kitchen oven. Waiting longer than 6 to 8 hours for that vital 30 minutes at over 160°F presents a danger of spoilage caused by bacteria growing under ideal conditions (100 to 130°F).

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

Use a standard meat thermometer to check the internal temperature of the largest piece in the smokehouse. This should ensure that all the fish has reached 160°F. (Some smokehouses may have cool spots.) A long-stemmed dial thermometer inserted into the fish through a hole in the smokehouse wall may be desirable; it allows temperature monitoring without opening the door.

It’s best to wait 3 to 5 hours before elevating the fish to the 160°F+ internal temperature. This is easier to do after most of the moisture is gone, and there will be less tendency for a baked fish flavor. In addition, there will be less “curd” formation caused by juices boiling out of the fish.

You can do further smoking and drying after the 30 minutes at over 160°F. Keep the fish temperature above 140°F to prevent growth of harmful bacteria. However, some oily fish (such as sablefish) may never “dry out” the way salmon or tuna do.

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

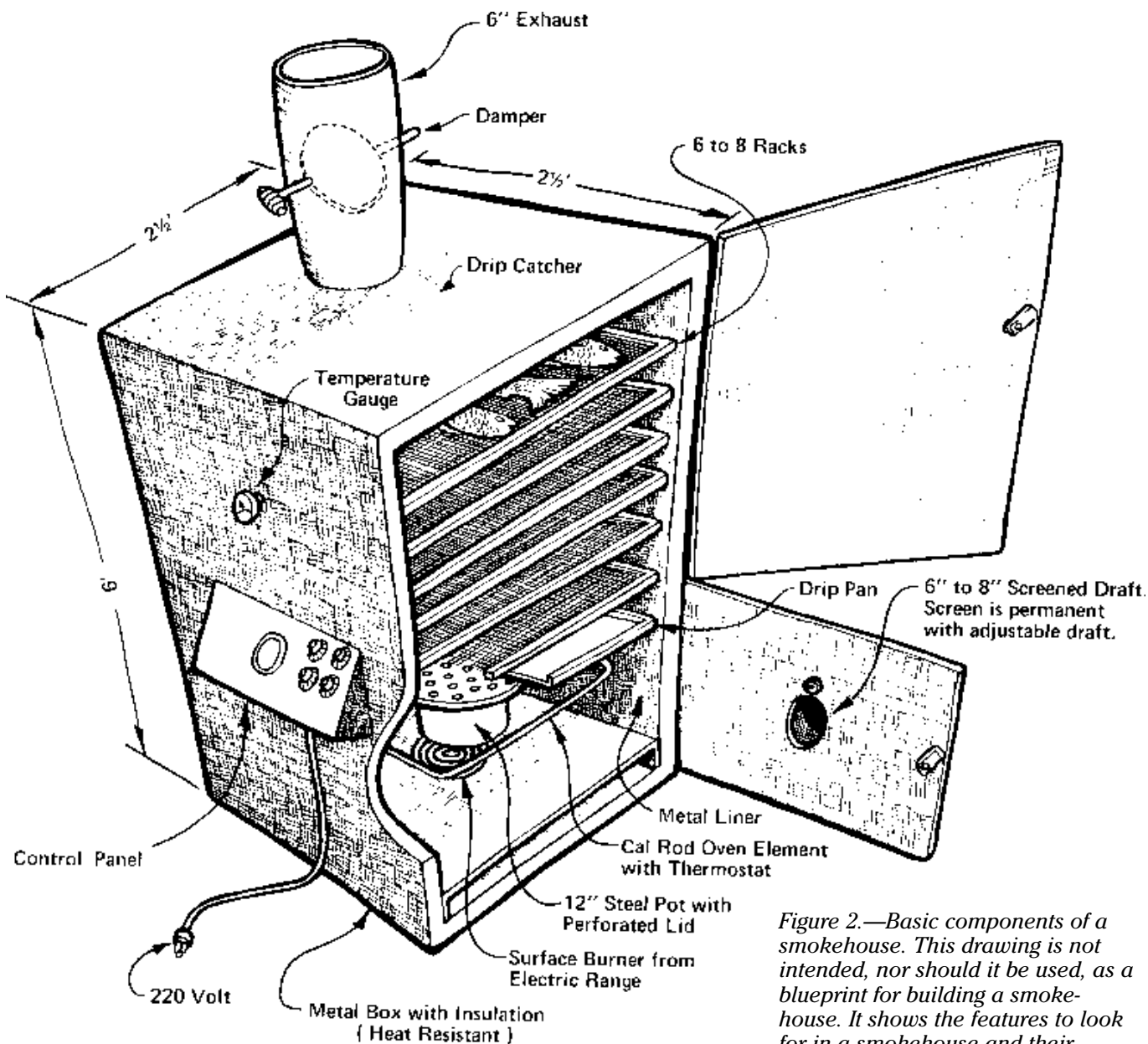


Figure 2 illustrates the basic components of a good smokehouse.

A common question asked about fish smoking relates to the small metal smokers readily available in most hardware or sporting goods stores. This equipment may be adequate, but it has difficulty reaching temperatures high enough for proper cooking. So if you do use one of these small devices, you may need to use your kitchen oven to

achieve the 30 minutes at over 160°F internal temperature.

Storage

Freeze or refrigerate your smoked fish (below 38°F) if you do not plan to eat it immediately. *This is essential*; the salt content is unknown, and there may be doubt about the time and temperature achieved in the smoking cycle.

Figure 2.—Basic components of a smokehouse. This drawing is not intended, nor should it be used, as a blueprint for building a smokehouse. It shows the features to look for in a smokehouse and their general arrangement. The key features are: (1) an independent source of heat for the pot of wood chips or logs; (2) a controllable vent, or flue, at the top; (3) a controllable draft at the bottom; and (4) some thermostatic control over the oven temperature, connected to (5) another heat source to raise temperature in the smokehouse to 200 to 225°F.

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 is especially severe if you place warm, plastic-wrapped fish in a refrigerator.

If storing longer than 1 to 2 weeks, tightly wrap and freeze smoked fish. Little quality is lost in freezing smoked fish because of its low moisture content. (For instructions on correct packaging for freezing, see the Oregon State University Extension Service publication EC 1363, *Home Freezing of Seafood*.)

Liquid smoke and sodium nitrite recipes

Liquid smoke and sodium nitrite are used in some home recipes. It's recommended that you do *not* rely on them for product safety. The *only* thing you can rely on is adequate refrigeration.

Time-temperature requirements

While regulations for commercial fish smokers may permit a minimum temperature lower than 160°F (30 minutes), home smokers don't have the continuous time-temperature recording equipment necessary to ensure proper cooking.

Therefore, I continue to recommend 160°F (30 minutes) as the minimum internal temperature for home smokers.

3½% WPS

This phrase ("WPS" stands for "water phase salt") means that the salt content is 3½% of the moisture

left after smoking. It's the minimum level of salt recommended by the U.S. Food and Drug Administration for commercial products. Although most home smokers don't measure %WPS, it's good to keep in mind that a definite level of salt is required for safety and that *adequate refrigeration is the only safeguard for those who cannot measure WPS*.

For further information

Most bookstores and sporting goods stores carry a variety of books on "smoke cooking." Most 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

For more information, contact:

Publication Orders
Extension & Station
Communications

Oregon State University
422 Kerr Administration
Corvallis, OR 97331-2119
tel. 541-737-2513

fax 541-737-0817
puborders@oregonstate.edu
<http://eesc.oregonstate.edu/>

In Idaho:

Agricultural Publications
University of Idaho
P.O. Box 442240
Moscow, ID 83844-2240
tel. 208-885-7982
fax 208-885-4648
agpubs@uidaho.edu
<http://info.ag.uidaho.edu/>

In Washington:

Bulletin Office
Cooperative Extension
Washington State University
P.O. Box 645912
Pullman, WA 99164-5912
tel. 509-335-2857
(toll free) 800-723-1763
fax 509-335-3006
bulletin@coopext.cahe.wsu.edu
<http://pubs.wsu.edu/>

Time and temperature recommendations are based on research conducted by Melvin W. Eklund, former director, Utilization Research Laboratory, National Marine Fisheries Service, Seattle, WA.

Pacific Northwest Extension publications are jointly produced by the three Pacific Northwest states—Oregon, Washington, and Idaho. Similar crops, climate, and topography create a natural geographic unit that crosses state lines. Since 1949, the PNW program has published more than 500 titles. Joint writing, editing, and production have prevented duplication of effort, broadened the availability of faculty specialists, and substantially reduced the costs for participating states.

Published and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914, by the Oregon State University Extension Service, Washington State University Cooperative Extension, the University of Idaho Cooperative Extension System, and the U.S. Department of Agriculture cooperating.

The three participating Extension Services offer educational programs, activities, and materials—without regard to race, color, religion, sex, sexual orientation, national origin, age, marital status, disability, and disabled veteran or Vietnam-era veteran status—as required by Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, and Section 504 of the Rehabilitation Act of 1973. The Oregon State University Extension Service, Washington State University Cooperative Extension, and the University of Idaho Cooperative Extension System are Equal Opportunity Employers. Revised October 1991; reprinted May 2003. \$1.00