

In many regions of Nova Scotia, smoking meat and fish is a popular activity. There are several provincially and federally approved meat processing facilities and food establishments that smoke products for commercial sale and distribution. Whether these foods are prepared for personal or commercial use, significant food safety issues can arise if improper food safety practices occur prior to, during, or after the smoking process.

The specific risk factors covered in this factsheet are based on the science of the survival, growth, and toxin production of disease-causing (pathogenic) microorganisms that can cause foodborne illness.

Smoking Processes

The following will discuss regionally popular methods of food smoking, the risks associated with the methods, and how to reduce these risks through specific food safety controls.

There are many methods of smoking foods, depending on the food product itself, the smoking agent used, and the desired characteristics of the end product. The methods described usually involve introduction of smoke to the food surface via burning untreated sawdust, chips, sticks/ logs, or vapourizing liquid smoke, depending on the style of the smoker unit.

Smoking foods can have some adverse effect on the growth of microbes, but the extent is usually minimal or too variable to be considered a primary food safety control factor.



Ready-to-Eat Smoked Meat

This method involves fully cooking the meat while adding smoke.

Examples: Fully cooked hams, jerky, most back bacon, North American style pepperoni and salami, smoked beef

Risks and Risk Controls

Risk # 1 - Incoming raw meat/ poultry typically have moderate to high microbial loads. Some of these microbes can lead to foodborne illness.

- **Control the risk** – Avoid cross-contamination when preparing meats prior to smoking; use appropriate cleaning and sanitizing methods for both raw and ready-to-eat (cooked) food contact surfaces; practice frequent and thorough hand washing; use additives known to control certain microbial growth in food (e.g., nitrites).
- **Control the risk** – Cook the product to the proper final temperature as found in the **NS**

Retail and Food Services Code; verify temperature with a calibrated probe thermometer; ensure the smoking unit has the capability to maintain consistent temperatures throughout the process.

Risk # 2 –Smoking product at very high temperatures in the absence of, or in very low humidity environments can dry the product out before it reaches a high enough temperature to kill some microbes. Therefore, the process intended to destroy the microbes only dries them out. If the food product is exposed to humidity at the processing level after smoking, or at the consumer level, these dried microbes can become viable and grow/ reproduce in the food, causing foodborne illness. This issue is of particular concern with less moist and thinly sliced products like jerky, or smoked fish (see section ‘Hot and Cold Smoked Fish’).

- **Control the risk** – Ensure your smoker unit has the ability to control levels of humidity during the hot smoke/ cook; verify the levels of relative humidity present during the cooking/ smoking process using wet and dry bulb temperature measurements; ensure your relative humidity levels are supported by reputable scientific sources and verified as effective in destroying microbes, particularly *E. coli* O157:H7 and *Salmonella spp.* for meat products.

Risk # 3 – Improper handling of smoked product in its ready-to-eat form prior to packaging could contaminate food intended to be eaten without further microbial destruction steps (i.e., cooking).

- **Control the risk** – Practice frequent and thorough hand washing; have a dedicated area (separate from raw meat handling areas) for cooling, handling, and packaging ready-to-eat meats; consider approved post-production interventions to destroy microbes, such as post production pasteurization or additives approved for use to reduce microbial activity in food.

Risk # 4 – Storage of packaged ready-to-eat products at room temperatures, or inconsistent refrigeration.

- **Control of Risk** – Any ready-to-eat meat product without shelf stability testing and verification must be kept at a controlled temperature of 4C (40F) or colder.

Not Ready-to-Eat Smoked Meat (Partially Cooked)

This method involves smoking meat without a full cook. The smoking process is mainly used to flavour the product, and to reduce the risk of a certain parasite. In addition to Risks # 1 and Risk # 4, there are some additional food safety risks for these foods.

Examples: bacon, most picnic hams

Risks and Risk Controls

Risk # 5 – Inadequate heating of meat to an internal temperature high enough to destroy the parasite *Trichinella spiralis*.

- **Control the risk** – Heat to an internal temperature of at least 63C (145F) for instantaneous destruction, or an alternative

time/ temperature combination as approved by NS Agriculture.

Risk # 6 – Consumers can assume the product is fully cooked, and eat it without cooking.

- **Control the risk** – Indicate on the label or verbally let your customers know at the retail level that the product is uncooked, and that they must cook it prior to consuming; for bacon and uncooked hams, the product must reach an internal temperature of 70C (158F).

Hot Smoked Fish

This method is typically the same as the ready-to-eat smoked meat process, utilizing a different food product. In addition to Risks # 1, 2, 3, and 4, there are some additional food safety risks for products made in this manner.



Examples: smoked alewife (a.k.a., kiack or gaspereau) smoked eel, hot smoked haddock, smoked mackerel

Risks and Risk Controls

Risk # 7 – Naturally occurring bacteria on fish and bacteria introduced to the fish surface can produce biogenic amines (e.g., histamine) if fish are left at temperatures over 10C (50F) for extended periods of time.

Control the risk – If sourcing your own fish, cool quickly using ice in coolers; use good personal hygiene practices (hand washing prior to handling fish); if sourcing from a supplier, ensure that the product has remained consistently at temperatures 4C (40F) or colder.

Risk # 8 – As Risk # 2 described, smoking at very high temperatures in the absence of, or in very low humidity environments can dry the product out on the surface before it reaches a high enough temperature to kill some microbes within the product. The organism of concern with all smoked fish (hot and cold smoked) is Listeria monocytogenes.

- **Control the risk** – Same control methods as listed in Risk # 2.

Risk # 9 –Fish may not be gutted prior to smoking. This could pose increased food safety risk associated with the bacteria C. botulinum and production of the toxin C. botulinum type E. This issue has prompted government agencies in some countries to prohibit the practice of using un-eviscerated fish at the commercial level.

- **Control the risk** – Gut fish prior to smoking; develop and scientifically verify a process that prevents the development of C. botulinum type E production using other control factors such as salt, temperature

control, and shelf life. Note that gutting fish will not completely eliminate the risk of C. botulinum presence in/ on the fish.

Risk # 10 – Fish may be vacuum packaged, or packaged in a low oxygen container; if C. botulinum organisms are present, it could provide an environment for C. botulinum toxin production, since this toxin can be produced at refrigeration temperatures.

- **Control the risk** – Freeze any vacuum packaged or reduced oxygen smoked fish product; ensure labels are present for consumers instructing them to open the package prior to defrosting at refrigeration temperatures (4C (40F) or colder).

Cold Smoked Fish

This method involves smoking fish without cooking it. The slow smoking process (ranging from 6 to 24 hours) serves to flavour the product, with temperatures rarely exceeding 30C (86F).

Risk # 7, 9, and 10 all apply to the cold smoking process for fish, but there are additional factors associated with the process:

Examples: cold smoked salmon, herring, halibut, cod, haddock, arctic char



Risk # 11 – Cold smoked fish does not typically reach temperatures high enough to destroy the organism, Listeria monocytogenes. Salted cold smoked fish also does not have salt levels high enough to inhibit the growth of these specific bacteria.

- **Reduce the risk** – There is no known control measure to eliminate L. monocytogenes on cold smoked product, unless it is cooked prior to eating, by the consumer. This is not a popular practice. There are some practices that may reduce these bacterial numbers such as using scientifically verified cold smoking time/ temperature procedures that do not exceed 24 hours; relying on well-established and verified environmental cleaning and sanitation controls; high staff hygiene standards; using approved additives to inhibit Listeria growth.

Risk # 12 – Cold smoked fish does not reach temperatures high enough to destroy parasites common to raw fish (roundworms, tapeworms, and flukes).

- **Control the risk** – Freeze fish prior to cold smoking using the temperatures outlined in the **NS Retail and Food Services Code**.

For more information on food safety, contact your local Food Safety Specialist, or visit the Department of Agriculture's food safety website at <http://www.gov.ns.ca/agri/foodsafety>