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## Bacterial Spoilage

Just like the fungi, bacteria are everywhere. They're in the water, soil, air, on you, your food and your food storage containers. Fortunately, the vast majority of the bacteria we encounter are relatively harmless and only a few represent a danger to us and our stored foods.

Bacteria can be very much more difficult to kill off than molds and insects. Some of them are capable of continued growth at temperatures that would kill other spoilage organisms. When conditions are such that they are unable to grow, some bacteria can go dormant and form spores. These spores can be quite hardy, even to the point of surviving a rolling boil.

In order to grow, bacteria need moisture, some as little as a 20% moisture content. For dry grains, legumes, powdered milk and other low moisture foodstuff bacterial spoilage will seldom be a problem so long as the moisture level in the foodstuff remains too scant to support its growth. For this reason, it is imperative that such products be drier than 20% and preferably below 10% to ward off mold growth as well. The botulism bacteria need moisture in the 35% range to grow. Thus, using desiccants in your food packaging is also an excellent idea.

**WARNING:** It is in wet pack canned goods (where the container has free liquid in it) and fresh foods we must be the most concerned about spoilage bacteria. It is here that a little bad luck and a moment's inattention to what you are doing

could kill or seriously injure you or some other person who eats the foods you've put by. In both home-canned and commercially-canned goods, IF THE CAN IS BULGING, LEAKING, SMELLS BAD, OR SPEWS LIQUID WHEN YOU OPEN IT THEN THROW IT OUT! But, throw it out safely so that children and animals cannot get into it.

## Botulism

*Clostridium botulinum* is one of the oldest types of life forms found on the planet. Like the gangrene bacteria, it is an anaerobic organism meaning it lives and grows in the absence of free oxygen. It forms spores when conditions are not suitable for it to grow and it is commonly found in the soil. This means it can be brought into your life on raw produce, tools, hands or anything else that came into contact with dirt. To further complicate matters, botulinum spores are extremely heat-hardy. The bacteria itself can be killed by exposing them for a short time to boiling water (212 F AT SEA LEVEL PRESSURE), but their spores can not. To kill them, the food product and container must be exposed to temperatures of 240 F (AGAIN AT SEA LEVEL PRESSURE) for a long enough period of time to allow all of the food in each container to come completely up to the proper temperature. Only a pressure canner can reach the necessary temperature.

It's not the bacteria or its spores which are directly deadly, but the toxin the bacteria creates when it grows and reproduces. In its pure form, botulism toxin is so potent that a mere teaspoon of it would be enough to provide a fatal dose to hundreds of thousands of people. It is this lethality that is why every responsible book on canning, food preservation, food storage, and the like hammers constantly on the need for care in technique and method and why spoilage must be taken so seriously.

*C. botulinum*, like any other life form, must have suitable conditions for it to grow and become a danger to you. One of the conditions it must have is a suitable pH range in its environment. pH is the measure of the acidity or alkalinity of a substance and is measured on a scale of 1-14 with anything above 7 being considered alkaline and everything below 7 being considered acid. If the pH of your wet pack food is BELOW 4.6 then botulism is unable to grow. Keep in mind pH is not eternal in foods and it is possible for it to change. If it should change to a lesser acidity than 4.6 pH your previously botulinum-proof food may start allowing the lethal spoiler to grow (see [molds in canned goods](#)). This is why it is vital to use proper technique, even for acid foods like tomatoes. It has been found that when this occurs and botulinum becomes active and produces its lethal toxin it also produces minute amounts of acid which can lower the pH of

the poisoned food back into what should have been the safe zone had the pH not jumped up and allowed the bacteria to grow. Again and again -- use good technique and pay attention to what you are doing.

Botulinum toxin, unlike fungal mycotoxins, can be destroyed by boiling the food briskly in an open vessel for fifteen minutes. Because of this, if your canned food shows *any* safety problems you should follow this procedure. If the food shows even the slightest mold growth, keep in mind that mycotoxins are not for the most part broken down by heat and dispose of the food safely.

I don't intend to go into the hows of home canning here. For that I strongly recommend that you read sections 1, 4, and 5 of the r.f.p. FAQ and most especially the book *Putting Food By* for in depth information on this subject.

## Other Bacterial Spoilers

This section will be in a future version of this FAQ.

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