Well, I'm stumped. Yes, I teach food safety. Yes, I have asked the local health department. And, no, I still do not have an answer. The question is based on the safety of oils with seasonings.

I am well aware of the safety implications of fresh garlic in oil mixtures. I completely comprehend the botulism risk of fresh garlic in oil left in the temperature danger zone. So, can I successfully immerse DRY seasonings in oil and leave it at room temperature?

How do quick-serve, formula operations do it? While at Bertucci's today, they served a quite tasty dipping oil that obviously had flecks of crushed red pepper, fresh rosemary and chopped garlic. So, are they preparing it daily? It didn't taste 'raw;' rather it tasted as if the seasonings had been well immersed for quite some time. So, are they refrigerating the mixture? It wasn't cloudy, so I don't think so.

If I want to serve an infused oil without risking foodborne illness, can I use dried garlic, dried rosemary and crushed red pepper?

Your thoughts, please

Jim,

My rule of thumb is ten days max with infused oils, and I keep them in the fridge. The cloudiness does not effect there flavor at all.

The oxygen free environment is what botulism thrives in. You can add a little citric acid to help ward off Bactria, always make small batches and toss what you don't use. Bertucci's I'm sure is using heat stabilized oils purchased from and FDA approved vendor, or there using oils that are citric acid or phosphorus supported.

Oh caped one :chef:. Thanks for the input. Gotcha. I know the cloudiness isn't a factor with flavor, but it does affect appearence. And since botulinum is an anerobic breeder, how much citric acid is enough? I have seen some people drop an orange rind into the mix. Is that sufficient? Or could I heat the oil to, say, over 140*, cool it and then add the infusion ingredients? Or, what if I cook the ingredients prior to adding them to the oil? Wouldn't that kill the bacterium? Or, for sake of ease, just add dry seasonings without any risk?

Dec 26, 2004

keeperofthegood
Hey oh

Well, botulism is a soil borne bacteria. So it is carried on the stuff you are considering putting into the oil. So, heating or otherwise sterilising the oil before adding to it is pointless (actually, oil is already a fairly sterile environment). If you use fresh, greenhouse hydroponically grown ingredients that are also carefully washed then you have minimised the risk. I would also research the acidifiers with the federal regulatory body first. I do not think that the citric acid is oil soluble, and if so would provide no acidification of your oil.

Hey oh

So what about adding dried ingredients? Aren’t most dried seasoning irradiated?

I too have been concerned in the past as to how to approach this safely. I contacted Dr. Brian Nummer at the U. of Ga. He is a Ph.D scientist there. He helped me this past summer with some canning safety concerns. I asked him about the discussion here, and this was his reply.

The above mentioned link to the consortium is this: http://www.arches.uga.edu/~bnummer/the-consortium.htm

I tried to upload the Word doc. but it was too large. I can either e-mail it to whomever may be interested, or perhaps someone can host it.

As stated in the response that chrose received it is the moisture that allows botulism to grow. If you are using dried herbs and spices I don’t think that there is much of a threat, if any. If there was, then wouldn’t dried spices and herbs need to be kept under refrigeration at all times also, especially before they are opened for the first time? It is only when you add moisture laden foods (ie garlic, fresh herbs, etc.) to the oil that the potential for growth is there. Of course I am not a food chemist or even a “health official” so I can only speak from my limited understanding of the issue.

Hey oh

Well, I am as you know, not a professional industry person. I make for myself at home. I have tried the dried herbs and simply find they do not do as good a job of flavouring the oil as fresh. I will take things like a fresh rosemary branch, lightly bruise it with a rolling pin or my hands and immerse that in the oils. I also don’t save any for the next day, I will make what I need when I need it.

I would be interested in that doc all the same though. I’ll pm you my e-mail.
Current Issues in Home Preservation of Vegetables and Herbs Stored in Oil

B. A. Nummer1, D. W. Schaffner2, and E.L. Andress1

1National Center for Home Food Preservation
Department of Foods and Nutrition, University of Georgia and
2Food Science Department, Rutgers University

April 2004

Abstract

Vegetables and herbs preserved by covering in oil potentially provide four conditions necessary for botulinum toxin production: (a) absence of oxygen, (b) pH greater than 4.6, (c) the presence of Clostridium botulinum spores, and (d) the presence of water. Outbreaks of food poisoning have occurred in these types of products (3,4,8,16). While the U.S. FDA issues regulations for commercial processors governing acidification of select foods before storage in oil, they do not regulate home food preservation. Recommendations for consumers from various land-grant university partners in the Cooperative Extension System on this topic vary and no clear guidelines exist. This publication reviews the current issues in consumer food safety with regard to vegetables and herbs stored in oil.

Outbreaks of botulism implicating vegetables and herbs in oil

In 1973, seven persons contracted botulism after eating improperly canned vegetables in oil. Commercially canned peppers in oil were implicated epidemiologically, and type B toxin was identified in leftover peppers. The processor voluntarily recalled the pepper product, and no further cases were reported (26). In 1985, 37 people acquired botulism from a garlic-in-oil preparation made in a restaurant (20). This was followed by a laboratory investigation indicating the survival of and toxin production by C. botulinum in garlic-in-oil preparations (21). Following a second botulism outbreak from garlic-in-oil in 1989, the FDA ordered the removal from store shelves of commercial garlic-in-oil preparations that lacked an acidifying agent (phosphoric or citric acid), and required that all future preparations contain the acid. In 1993 two separate incidents of botulism food poisoning occurred in Italy due to contaminated eggplant stored in oil (3).

Other outbreaks of botulism have implicated home prepared vegetables or herbs covered in oil. As recently as 1998 a case in the USA of botulism type A implicated home prepared mushrooms covered in oil (16) and two cases implicated mushrooms covered in oil in Britain (17). In Italy, where this method of home food preservation is popular, there have been 88 cases of botulism in 1995-6 alone resulting from these home prepared...
vegetables or herbs stored in oil (17). These outbreaks demonstrate the significant hazards associated with this method of food preservation.

Clostridium botulinum
A summary of Clostridium botulinum and botulism can be found in the U.S. FDA- CFSAN Bad Bug book (13) and in the International Commission on Microbiological Specifications for Food, Microorganisms in Foods. (27). There are numerous strains of C. botulinum, but they are commonly grouped into two major groups.

Group I - Mesophilic strains
C. botulinum strains A, and proteolytic strains of B and F collectively have very heat resistant spores. Temperatures associated with home pressure canning would be required to kill these spores in a reasonable period of time. These strains are inhibited by acid (pH below 4.6) and salt (greater than 10%)(15).

Group II - Psychrotrophic strains.
C. botulinum strain E and non-proteolytic strains B and F have the ability to grow at refrigeration temperatures; however their spores are much less heat resistant. Pasteurization temperatures that could be achieved in home boiling water canners could kill these spores. These strains are inhibited by acid (pH below 5.0) and salt (greater than 5%; 15) and are commonly associated with seafood products. Non-proteolytic strains do not produce overt signs of food spoilage.

Table 1. Growth Limits of C. botulinum (27)

<table>
<thead>
<tr>
<th>Growth Limits</th>
<th>Heat Resistance (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. Temp</td>
<td>pH</td>
</tr>
<tr>
<td>Mesophilic/</td>
<td>1</td>
</tr>
<tr>
<td>proteolytic</td>
<td>10^°C</td>
</tr>
<tr>
<td>cells</td>
<td>C4.60.22</td>
</tr>
<tr>
<td>or 5.5% NaCl-0.15 toxin</td>
<td>0.2</td>
</tr>
<tr>
<td>1.5 cells</td>
<td></td>
</tr>
<tr>
<td>1 Under optimal growth conditions.</td>
<td></td>
</tr>
</tbody>
</table>

Summary of recommendations to consumers

U.S. FDA recommends that consumers not prepare any homemade spice-in-oil, -margarine, or –butter for extended storage at room temperature (2). The U.S. FDA issued two bulletins regarding foods stored in oil directed to the commercial food processing industry. In 1989 they issued a statement that FDA has prohibited commercial manufacturing of garlic-in-oil mixes that require refrigeration for safety (1). Manufacturers were required to add microbial inhibitors or acidifying agents and disclose these additives on their labels. They also urged consumers to discard such products. In 1993 the FDA released another bulletin warning consumers and food service workers to refrigerate garlic-in-oil, garlic-in-butter, and garlic-in-margarine mixes (2). There was a recognized risk of botulism food poisoning if these products were left at room temperature. In 1999, garlic-in-oil mixes were recognized as potentially hazardous foods for the first time in the FDA Model Food Code (2).

The USDA Complete Guide to Home Canning recommends two recipes for home canning for marinated peppers (19) and marinated whole mushrooms (20). Each recipe contains lemon juice for acidification and salad oil.

Oregon State University Extension Service recommends that raw or cooked garlic and/or herbs in oil must be refrigerated, and for no longer than 3 weeks (10). Room temperature storage is considered safe for oil seasoned with dried garlic and/or dried herbs; refrigeration is offered as an option to delay rancidity. Unseasoned dried tomatoes in oil are considered safe for storage at room temperature, also, as are dried tomatoes seasoned with raw or cooked garlic and/or herbs if they are added to tomatoes before drying. If the raw or cooked garlic or herbs are added after drying, refrigeration is recommended as a “must”; a maximum refrigeration shelf life of 3 weeks is given. Dipping dried tomatoes in bottled lemon juice or 5% vinegar before placing them in oil is offered as an option to help them soften more quickly. Flavoring the tomatoes with dried herbs and garlic is permitted for room temperature storage in oil (10).

The Oregon fact sheet provides directions for a “hot infusion” method of preparing garlic, vegetable or herb flavored oils are provided; indefinite room temperature storage of the strained oil is allowed, with refrigerator or freezer storage recommended for long-term storage. If not all the garlic is removed, refrigeration storage, for no more than 3 weeks, is required. Refrigerator storage up to a maximum of 3 weeks is recommended for pesto, as it is for mushrooms or chilies in oil unless the latter have been pickled with vinegar or lemon juice (10).

The University of Georgia Cooperative Extension Service provided recommendations to county agents based on review of other state recommendations and previous cautionary advice from FDA. Their recommendations for herb-flavored oil include a “cold infusion” where herbs are blanched in water. The well-drained blanched herbs are then pureed with olive oil. This mixture is strained several times; the strained flavored oil is then refrigerated for recommended use within 3 days. Also recommended is an infusion method of flavoring oils by heating washed, dried and minced herbs in oil at a “very” low temperature. Again, this oil is strained and then refrigerated for recommended use within 3 days. Lastly, the recommendations describe storage advice for a pesto (basil, garlic, pine nuts and oil) being to make fresh and store in the refrigerator no more than 3 days; alternatively, it can be frozen for longer storage. The University of Georgia does not recommend room temperature storage for any fresh or
dried herbs or vegetables packed in oil. No home canning recommendations are made for any of these products; in fact, the fact sheet cautions about botulism concerns.

University of California, Davis recommendations offer several options for vegetables and herbs in oil. A fact sheet on garlic states that acidifying garlic to store it in oil is not recommended for home preservers; however, it is allowed that properly dried garlic cloves can be safely added to flavor oils (7). Freezer storage of up to several months is recommended for peeled garlic cloves submerged in oil in the freezer for up to several months, but also adds a recommendation that this product may be stored in the refrigerator for up to three weeks maximum. Dating is again recommended. It is recommended that pesto can be safely refrigerated for a maximum of three weeks or frozen until quality suffers. The caution against storing garlic in oil and pesto at room temperature is given. As long as no fresh herbs or fresh cloves of garlic (or other vegetable) are added, room temperature storage of dried tomatoes packed in oil is recommended as safe until the oil turns rancid (11).

Preservation Hurdles

Consumer processing recommendations for vegetable- or herb-in-oil mixtures should take into account the different recipes and intent of the consumer: (A) dried tomatoes in oil, (B) dried herbs in oil for consumption or for decorative gifts (C) infused oils, (D) garlic-in-oil, (E) other vegetables-in-oil, and (F) marinades or dressings. In the case of gift giving there would be a period of room temperature storage expected.

Refrigeration. The best and current science-based recommendation for consumers is to refrigerate vegetable- and/or herbs-in-oil mixtures at or below 40°F. Outbreaks of botulism cited in this review were due to Group I (heat resistant) C. botulinum strains contaminating vegetables or herbs stored in oil at room temperature and not of products properly refrigerated. Temperatures below 50°F will inhibit the growth of Group I strains of C. botulinum.

To prevent the growth of Group II (psychrotrophic) strains of C. botulinum refrigeration temperatures would have to be maintained below 38°F. However, it is unlikely that these types of botulism spores would be found in vegetable products. Should the consumer get creative and add non-vegetable material with the potential for containing these types of botulism spores, refrigeration would need to be accompanied by additional hurdles (time, acid, heat, or low moisture) to prevent the growth of the psychrotrophic strains.

Refrigeration shelf life. Early U.S. FDA communications recommended a three day refrigeration shelf life for vegetables- and/or herbs-in-oils. The University of Georgia recommends vegetables and/or herbs in oils be refrigerated for up to 3 days (9) and Colorado State University recommends 10 days (12), while other sources list a shelf life of up to three weeks (7, 10, 11). It is believed that these shelf-life times were determined from the minimum time required at refrigeration temperatures for the outgrowth of botulism.

Commercially, the U.S. FDA Food Code (2001, Sec 3-501.16) states foods can be stored at 5°C (41°F) or less for a maximum of 7 days; or (b) At 7°C (45°F) or between 5°C (41°F) and 7°C (45°C) for a maximum of 4 days in existing refrigeration equipment that is not capable of maintaining the food at 5°C (41°F) or less. Based on research studies with C. botulinum the Advisory Committee on the Microbial Safety of Food in the United Kingdom (23) and the European Chilled Food Federation (24) recommended the following procedures for the safety of chilled foods in reduced oxygen environments to minimize the hazards associated with C. botulinum:

Table 2. Chilled Foods GMP (23, 24)
<table>
<thead>
<tr>
<th>RefrigerationStorage Time</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>below 3˚C</td>
<td>No additional hurdles are required</td>
</tr>
<tr>
<td>less than 10 days</td>
<td>No additional hurdles are required</td>
</tr>
<tr>
<td>3-5˚C</td>
<td>Less than 4.5 days No additional hurdles are required</td>
</tr>
<tr>
<td>5-10˚C</td>
<td>More than 10 days At least one additional hurdle is required (see a-e below)</td>
</tr>
</tbody>
</table>

Additional hurdles suggested: (a) minimum heat treatment of 90°C for 10 minutes, (b) pH of 5.0 or less, (c) waterphase NaCl of 3.5% throughout the product, (d) Aw equal or less than 0.97 or (e) any combinations of these factors experimentally proven to reduce viable spores by a factor of 106.

Freezing. Maintaining a temperature below 38°F would be difficult for consumers, except in the case of freezing. Freezing is the safest method to recommend for storage of vegetables and/or herbs in oil. The oils would remain liquid and could be used straight from the freezer in exact quantities needed.

Heat treatment. There are several heating processes used in home preservation of vegetables and/or herbs covered in oil. Each has both positive and negative attributes to the hazards of food safety (Table 3.).

Table 3. Heat Processing Vegetables- and/or Herbs-in-Oil
<table>
<thead>
<tr>
<th>Heat Treatments</th>
<th>Positives</th>
<th>Negatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Infusion</td>
<td>Kills psychrotrophic Clostridium cell so Requires sterile container and sterile transfer to maintain asepsis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>oDoes not kill Clostridium botulinum spores</td>
<td></td>
</tr>
</tbody>
</table>
The "hot infusion" method produces flavored oil and not a product where herbs or vegetables are stored in the oil. Herbs or vegetables are heated in oil to extract flavors. The oil is cooled and strained to remove the herbs and then refrigerated (9). This method is mostly used to get flavorings from vegetables or herbs into the oil.

A bulletin from Tulare county California Cooperative Extension has a recommendation for boiling water canning of sun-dried tomatoes in oil (11). The directions are to place dried tomatoes in a bowl, sprinkle them quickly with distilled white vinegar, toss pieces to moisten them, and then dry them with paper towels. The tomatoes are lightly packed into clean pint or half-pint jars with optional spices. The tomatoes are then covered with olive oil to ½ inch from jar rim. The directions state to store jars in the refrigerator or to heat process at 170-190°F in a boiling water canner. Let cool and store in a cool, dark, dry place (11). Scientific validations are not mentioned and these directions do not appear in California Cooperative Extension publications suggesting this method may or may not be safe.

To permit room temperature storage a thermal treatment consistent with home pressure canning in approved canning jars would be required to kill all botulism spores. The only research-based recipes for vegetables with large amounts of oil are for mushrooms (19) and peppers (1) in the USDA Complete Guide to Canning. No thermal process exists for home canning other herbs or vegetables in oil.

Heat treatment and refrigeration. Heating the product at pasteurization temperatures sufficiently would destroy the spores of C. botulinum type E and non-proteolytic types B and F (psychrotrophs). Refrigeration would be a second hurdle to prevent the outgrowth of the mesophilic strains of C. botulinum. The refrigerated shelf life could be extended, since the growth of the mesophilic strains is inhibited at a temperature below 50°F. Further research is needed to recommend specific thermal processes. Proper labeling would be required to prevent the consumer from storing these products at room temperature.

Dehydration and refrigeration. Controlling the amount of moisture that is available in the product (water activity below 0.85) in a manner sufficient to prevent the growth of C. botulinum types A,B,E, and F and other pathogens that may be present in the product could be difficult (15). Since water forms droplets in oil, even the smallest amount can be sufficient to allow microbial growth (22) and botulism toxin formation (21). Adding dried vegetables and herbs to oil for the purpose of room temperature storage has been recommended by several researchers (7, 10, 11). For dried vegetables, dried herbs, or sun-dried tomatoes stored in oil two different recommendations exist. One recommends storage at room temperature with minimal risk of botulism providing the added food was thoroughly dried. However, no shelf life was given and it is assumed that product rancidity would determine shelf life. The second recommendation was that there is still a risk of botulism in these products and they should be stored in the refrigerator. Research in this area may clarify risks and hazards and the potential for adding additional hurdles can be addressed.

Acidification and refrigeration. Acidification of vegetables and/or herbs in oil is a commercial hurdle employed to inhibit C. botulinum outgrowth. No published research applying this concept to the consumer environment has been found and therefore it is not recommended to consumers. Colorado State University recommends adding 1 teaspoon of lemon juice or vinegar per 1 cup of oil to vegetable or herb in oil mixtures that are to be refrigerated (1). Australia (CSRIO) recommends to consumers that vinegar should be added to the vegetable component of these preserves before any oil is added so that the ratio of vegetable to vinegar by weight is not greater than three to one. For example, to make 400 grams of preserved garlic, one would mix 300 grams of garlic with 100 grams of vinegar. The resultant mixture will then contain approximately one percent acetic acid which would ensure a final pH below 4.6. This will not guarantee that the products will not spoil if not kept properly refrigerated, but it will ensure they do not become toxic (5). The other barriers (salt and moisture) have not been studied relative to this topic. However, one source recommends that it would be safe to store pickled foods in oil at room temperature and another mentions adding 1 teaspoon of lemon juice to 1 cup of oil as an added barrier together with refrigeration. These recommendations lack research to support them and further research would be needed to assess their safety.

Antimicrobial preservatives and refrigeration. Controlling botulism in vegetables and/or herbs in oil with the use of salt or preservatives does not appear practical. Lactates and acetates have antimicrobial properties against Clostridium, however these chemicals would be hard to obtain and hard to use by consumers. An incorrect assumption is often made that some herbs and spices, especially garlic, have significant anti-microbial preservative properties. The preservative effect of these materials is slight and inconsistent as the botulism incidents demonstrate. In fact, the antimicrobial properties of garlic may have contributed to the outbreaks. The garlic didn’t spoil, yet the botulism organism grew.

Dehydration, acidification, and refrigeration.

High acid sun-dried tomatoes have a pH of approximately 4.0 and are considered low risk to store in oil as long as enough moisture is removed in the drying process. When the tomatoes are dried, the natural acid components are concentrated and the pH is reduced (5). It will often be close to 4.0 in the dry product and therefore the risk is minimized. No such safeguard exists with other vegetables or herbs (5). It is possible that an optional dip in lemon juice or vinegar to soften the dried tomatoes before storage in oil would enhance the safety of this product. Further validation of the research behind storing sun-dried tomatoes in oil is required before consumer recommendations can be made.
Conclusions

A consensus is needed on the acceptable shelf life of refrigerated vegetable- and/or herbs-in-oil mixtures to present to consumers who choose to preserve these foods at home. It first needs to be decided whether the refrigerated shelf life maximum should be determined from the minimum time required for the outgrowth of botulism cells, toxin production, or another parameter. While consumer storage recommendations do not usually provide specific labeling guidelines, recommendations should stress the importance of labeling the container with "Important: must be kept refrigerated or frozen" (25) along with an appropriate discard date to prevent consumers from storing vegetables and/or herbs in oil at hazardous temperatures. Further studies are also needed for the added hurdles that could make these foods safer.

Acknowledgement

This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 00-51110-9762.

References

chrose, thank you for the post-very informative.

danny

And there it is!

Thanks for the info! :bounce:

I really liked the post by chrose and this topic. I was concerned with just kind of a followup on all those different version of what to do with infused oils.

Let's just say that I put garlic (with or without botulism on it) in oil. I then sterilize it through heating both the garlic and the oil. Does this now kill the botulism? If I were to then place it into a sealed container in the same manner as in canning (sterilized jars and seals) does that eliminate the opportunity for botulism to grow?

This would be different then having oil in an open jar on the counter but wouldnt it keep without any problems.

I mean there is a level of safety that you have to take but is this sound logic and science?

How hot are you going to heat it? What pressure? What pH? Those are all part of the recipe for sterilizing against and stopping the growth of the spores. It's the clostridium spores that are hard to destroy. This is why temps and pH matter for this this.  

Commercial processing for garlic oil meets careful standards that are beyond the home producer equipment and methods.

Wow this is an old thread all the way back to 04! Anyway I will add the following link to an article Chef John Draz did for us many moons ago.
regarding flavored oils.

http://www.cheftalk.com/a/how-to-make-flavored-oils

Great info and peace of mind. I stopped making infused oil since I found out about garlic and dumped my stash. It tasted so good too.

We were holidaying in Virginia last fall, prior to our sons wedding in Ohio. OH had to call into Fredericksburg to see if there were any Don Troyani prints that caught his eye. Like he has wall space for more!! and while shopping we found the most amazing shop for flavoured oils and vinegars called Taste. Its an experience for sure. One wall is lined with tapped barrels of flavoured extra virgin olive oil and the other is balsamic vinegars. You take wee paper cups and taste the lot, then buy what you want in 200ml stoppered bottles. The range is superb. We left with only 2...Raspberry vinegar and chipotle oil, but that was only 'cos we had to restrict for flights back to Scotland.

They have another branch in Culpeper too and I know they ship, so prob have a website. I would give them a try for sure.

PS I’m not on commission : )
You may use infused oils in cooking or in bath and skin products. There are so many herbs to choose from depending on the intended use. As an example of the many uses of herb infused oil let's take a look at rosemary. For culinary infused oils using dried herbs, I suggest starting with a sterilized, completely dry jar. Place herbs in the jar and cover with olive oil. Place this jar in a saucepan that has been filled ¼ full with water. Simmer this mixture for about 4-6 hours. After the jar has been removed from the bath cool and label with date and ingredients and keep refrigerated. Discard after a month. Learn about herbs as food and as medicine in the Online Intermediate Herbal Course. Herb-infused oils for wellness and beauty. Soon live crickets started showing up in the kitchen and bathroom. Mamma freaked because she thought they were the dead crickets come back to haunt, but Dad said they were definitely a new batch, probably coming up on the pipes. He fetched his jug of poison and sprayed beneath the sink and behind the toilet and all along the baseboard until the whole house smelled of poison, and then he sprayed the cellar again, and then he went outside and sprayed all around the foundation leaving a foot-wide moat of poison.