

Preservation of vegetables in oil and vinegar



Food Science Australia Fact Sheet

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It is now a relatively common practice to bottle vegetables and herbs and spices in either oil, vinegar or a mixture of both. This is done both commercially and domestically and the products should be refrigerated below 4°C.

Products which are treated in this way include chopped garlic, garlic cloves, sun-dried tomatoes, chilli, ginger, egg plant, capsicum, mushrooms and various mixtures of these and similar materials. While these products are safe if refrigerated, they represent a potential food poisoning hazard unless certain basic precautions are taken in their preservation.

This fact was unfortunately highlighted in Canada and the United States in the 1980s when two serious outbreaks of botulism occurred in which chopped garlic in oil was clearly identified as the source of botulism toxin. Botulism is a rare disease, particularly in this country, but because of its severe, debilitating symptoms and relatively high mortality rate remains a major hazard in home preserves.

Authorities in Canada and the United States reacted to the above incidents by preventing the sale of garlic-in-oil products in which refrigeration was the only barrier to the growth of the bacterium, *Clostridium botulinum* the organism which causes botulism. These products are now required to contain an additional barrier to *C. botulinum* such as acidification.

In 1991 Australian authorities took similar precautions by regulating that this class of product must not have a pH greater than 4.6. The pH of a product is a measure of its acidity. Foods with a pH below 4.6 do not in general support the growth of food poisoning bacteria including *C. botulinum*. The necessary pH adjustment for these products can be achieved only by adding acid to the vegetable material. Vinegar, which is a solution of acetic acid, is the usual choice. Citric acid and lemon juice are other possible acidifying agents.

Attempts to preserve these products without acidification seem to be based on two false assumptions. The first of these is that the addition of oil has a preservative effect. This is incorrect. The only function of the oil is to prevent oxidation from the air in the container which can lead to discolouration of some foods. By excluding air from the surface of the vegetable, one is establishing anaerobic conditions which actually favour the growth of some types of bacteria. Unfortunately, *C. botulinum* is one of these bacteria.

The other incorrect assumption which is often made is that some herbs and spices, and especially garlic, have significant anti-microbial properties. The preservative effect of these materials including garlic is slight and inconsistent as the botulism incidents in Canada and the United States prove.

It is therefore essential that sufficient acid is added to the vegetable before oil is poured on so that any *C. botulinum* or other potentially dangerous bacteria can not grow. Vinegar prepared for domestic use contains 4 percent acetic acid. 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.

If vegetable products e.g. tomatoes, are dried prior to being stored in oil, a different set of circumstances applies. Correctly dried vegetables and herbs will not support the growth of food poisoning bacteria but they may still support the growth of spoilage organisms such as yeasts and moulds. Moulds will usually only be a problem on exposed surfaces but yeasts bring about fermentation in the absence of air.

Vegetables and herbs to be packed in oil without treatment with vinegar should be dried almost to crispness. Tomatoes, including sun-dried tomatoes, are a special case. The pH of fresh tomatoes is normally just below 4.6. When the tomatoes are dried, the natural acid components are concentrated and the pH is reduced. It will often be close to 4.0 in the dry product and therefore the risk of food poisoning is eliminated. No such safeguard exists with other vegetables, however, and these must be either acidified or properly dried before being covered with oil. This includes small quantities of garlic or herbs which may be added to other preserved vegetables as flavourings.

Discolouration of bottled garlic in vinegar

Users of bottled garlic in vinegar are occasionally alarmed to find that the product has turned green or blue-green. These colour changes do not make the product unsafe but are obviously undesirable.

The problem of garlic changing colour is associated with the addition of acid which changes the normal pH of the product. This is precisely what is required to ensure that the garlic remains safe but the change in acidity brings about chemical changes in pigments in the garlic.

All plant materials contain various pigments some of which change colour as the pH of the plant tissue is changed by the addition of vinegar or other acids. The most common of these pigments are the anthocyanins which may be blue, colourless or red depending on the pH.

These pigments may be involved in some colour changes observed in preserved garlic but American scientists have identified another more general explanation.

Certain amino acids, natural components of foods, are responsible for many of the pigment characteristics of the onion family which includes garlic. The American scientists have shown that the outstanding difference in composition between garlic which turns green and garlic which does not is the presence of much higher levels of one particular amino acid in the green garlic.

It is not possible to tell by looking at untreated garlic whether it is likely to become green on crushing and acidification. However the work reported indicates that if garlic bulbs are stored for four weeks at a temperature above 23°C prior to processing, the production of the green pigment is prevented.

This may not be practical at the domestic level, but could be a valuable precaution for commercial producers.