



Food Safety Requirements for Table Olives and Infused Olive Oil

Introduction

The production of table olives and infused olive oil for home use has always been widely practiced in S.A. particularly among migrant families originating from Southern Europe.

The recent expansion of the olive industry has provided more opportunities for the production and commercial sale of olive products.

It is beyond the scope of this article to provide complete details of the requirements under the Food Act but full details may be obtained from the Department of Human Services, Food Section, Department of Health, Level 2, 150 Grenfell Street, ADELAIDE.

Website: www.dhs.sa.gov.au/pehs (click on "Food") or from FSANZ (Food Standards Australia & New Zealand) Website www.foodstandards.gov.au (Chapter 3; sections 3.1.1; 3.2.2; 3.2.3).

Regulatory Requirements

Under the South Australian Food Act 2001 the production of table olives or olive oil (infused or not) is deemed to be a Food Business. Food businesses are required to notify the local District Council by completing a Food Business Notification form providing: -

- a. contact details including the business name business and address of the Proprietor.
- b. the nature of the Food Business.
- c. the location of the Food Business.

Intending producers of table olives and infused olive oil need to have food handling skills, knowledge and controls as well as satisfying requirements for the premises and equipment to be used in the proposed business.

The remainder of the information specific to olives assumes that the above regulations are complied with.

NB: Producers in other states should contact the local authority.

HACCP

Hazard and Critical Control Point (HACCP) analysis is a voluntary system used by many businesses to identify and manage potential hazards during production. HACCP is particularly useful in a food business and is readily adaptable to the production of table olives and infused olive oil. Although the introduction and operation of a HACCP system is voluntary, the fact that a business has introduced and operates a HACCP system provides confidence in that business's products. Many purchasers, particularly supermarket chains require producers

to be both HACCP registered and have a Quality Assurance (QA) system certification in place.

The following seven principles are used to develop a HACCP plan: -

1. Conduct a hazard analysis.
2. Identify the critical control points in the process.
3. Establish critical limits for preventative measures associated with each identifiable control point.
4. Establish critical control point monitoring requirements.
5. Establish corrective actions to be taken when monitoring indicates that critical limits are not met.
6. Establish effective record keeping procedures.
7. Establish procedures for identifying that the HACCP system is working correctly.

Preservation

The object of any food preservation system is to treat the fresh product in some way to prevent it from deteriorating. If done correctly, preserving renders the product safe for human consumption over a longer time. Various methods of food preservation have been developed over thousands of years and some of them are still used today, although newer and more sophisticated methods are now more common. In general most methods involve changing the environment of the product to eliminate or inhibit spoilage microorganisms.



Table Olives

The production of table olives involves the use of one or more of the following preservation methods:

- a) Addition of salt.
- b) Reduction of pH by fermentation or by acid addition.
- c) Elimination of fermentable material
- d) Lowering of water activity.
- e) Addition of preservatives.
- f) Application of heat.
- g) Removal of oxygen.
- h) Prevention of oxygen access to the product.
- i) Addition of oxygen to encourage aerobic fermentation to use up fermentable material.
- j) Refrigeration and freezing.

Critical points pertaining to table olives:

POTABLE WATER SUPPLY: Only water that meets the standard for potable water should be used for the production of table olives. Table olives produced from water of unacceptable quality may be spoiled by undesirable microorganisms that can cause serious or even fatal illnesses if consumed.

Action: *Water should be initially tested (see section below re testing). If the water is not potable, obtain expert advice on water treatment and incorporate monitoring and testing in the HACCP and QA programs.*

GOOD HYGIENE: In most table olive production spoilage bacteria are introduced from an external source. Poor washing of the olives prior to beginning the pickling process is a major factor.

Action: *Taking simple precautions, such as having clean floors where hoses may lie and rinsing of pumps and hoses to prevent transfer from one container to another. Prevention of bird and animal entry is essential to eliminate faecal contamination.*

PHYSICAL HAZARDS: Take precautions to avoid solid materials such as stones, soil, glass fragments, metal objects, and organic foreign materials such as olive pits, hair, feathers, insects.

Action. *Identify potential problems in the grove, factory and during transport and initiate a HACCP program to monitor and eliminate these problems.*

CHEMICAL HAZARDS: Chemical applications must meet label requirements to avoid inorganic or organic spray residues. Heavy metal contaminants could occur from the use of non food grade processing aids (sodium hydroxide, sodium chloride).

Action. *Incorporate in HACCP program to identify and eliminate problem*

MICROBIOLOGICAL HAZARDS:

- Spoilage bacteria: coliform bacteria, propionibacteria, Zapatera spoilage (Clostridium butyricum) Cryptosporidium.
- Food poisoning risks include: *Salmonella, E.coli, Listeria.*
- Toxin producing: Clostridium botulinum, Staphylococcus.

Action:

- i. *Instigate HACCP plan above. Adoption of this plan will be of great value in eliminating contamination from outside sources. This action is particularly applicable to non-reticulated water supplies. If the water supply is not suitable and water treatment is needed to render it suitable then monitoring of the treated supply will have to be included in the HACCP plan.*
- ii. *Spoilage bacteria can largely be controlled by monitoring processing parameters particularly salt and pH levels in brine and by monitoring microorganism levels in the brine. As a general guide most spoilage bacteria are inhibited if*

the salt level is above 5% (preferably 6%) and the pH is below 4.5.

- iii. *Food poisoning. Adopting Food Safety and HACCP plans which involve the control most of the factors such as health of workers, personal hygiene, carriers of food borne diseases, poor food handling skills, poor cleanliness in the factory area, rodent and insect control should minimise this problem. Adequate control of salt and pH levels as described above is also vital.*

ORGANIC CONTAMINANTS:

Avoid contamination of harvested fruit from leaks and spills from harvesting and transport machinery. Fruit contaminated with diesel fuel, petrol, lubricating oil, hydraulic fluid should be rejected.

Action: *Incorporate in HACCP program to identify possible hazard*

Types of Table Olives



Green Table Olives

Lye treated Spanish green

Preservation achieved by a, b & c, above. Storage of final bulk product by h.

Critical practices and possible hazards:

HANDLING OF LYE: (Caustic soda, sodium hydroxide). Lye is a dangerous chemical and must be handled carefully as it can cause severe burns to the skin and even blindness if splashed into the eyes (and perhaps death if ingested). It is essential that the user obtain the relevant Material Safety Data Sheet (MSDS) from their sodium hydroxide (lye) supplier and follow the safety directions exactly. Eye protection and protective clothing and gloves are essential.

When lye treating olives, maintain a large open container of dilute household vinegar (about 25% vinegar: 75% water) on hand for neutralising and rinsing off any lye that may splash onto exposed skin.

LYE TREATMENT: Essential to be carried out correctly or spoilage of the product may occur. Excess lye treatment results in softening of the olive flesh and possible spoilage by undesirable bacteria. Insufficient lye treatment causes browning of the olive and possible “stuck” fermentation.

SPOILAGE: “Fish Eye” or gas pocket spoilage Can be caused by the presence of gram negative, gas forming bacteria of the coliform group. *E. coli* types may be present. The bacteria form colonies inside the olive and the gas they produce causes the olive flesh to split, causing a typical dark line under the skin. If

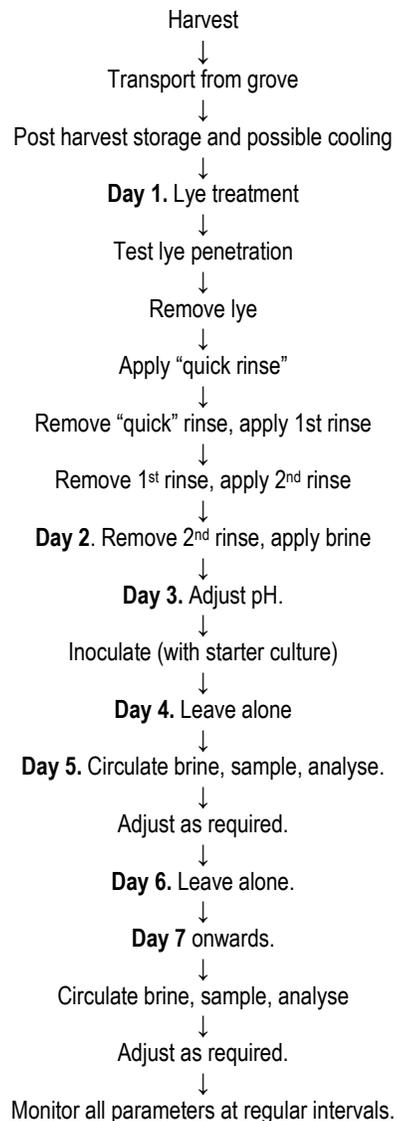
these bacteria continue to grow the olives will be completely spoiled, developing faecal odours and soft, mushy flesh. Control is achieved by pH reduction by acidification and by increasing the salt levels in the brine. Recently published information indicates that *E. coli* bacteria can remain viable at pH of 4.0 or less. See Microbiological hazards above.

Final pH at end of fermentation must be less than pH 4.2 to inactivate possible spoilage microorganisms.

Final salt (sodium chloride) level should be above 6.0%.

The surface of the brine in the container must be kept covered to exclude air thus preventing the growth of aerobic surface yeast and mould that can cause spoilage.

Lye treated - Green olive protocol



Untreated - Green olives in brine.

Preservation achieved by a & b.

Critical processes and possible hazards

- Supply of potable water is essential to this process
- HACCP requirements for cleanliness and elimination of possible contaminants from the grove are essential.

Process:

Washed olives may be directly covered with brine containing about 10% salt, sealed and maintained for a period of about 12 months, the salt level and pH needs to be monitored during this time. The bitterness in the olives will gradually reduce to an acceptable level.

The bitterness may be reduced more rapidly by initially covering the olives in water for 24 hours, discarding the water and replacing it daily for a period of up to 14 days until on the 14th day the rinse water is replaced with a 10% brine(100g/l) and the container sealed. The olives may be ready within a few weeks. In both methods the pH may be reduced to less than pH 4.2 by the addition of food acids such as acetic acid (vinegar) or lactic acid.

Turning colour olives

The methods supplied for untreated green olives in brine also apply to turning colour olives.

Aerobic fermentation. Turning colour olives i.e olives that are partially green and partially black may be turned completely black by aerobic fermentation. After brining the olives are subjected to a flow of fine air bubbles which induce aerobic fermentation, reduce fermentable material and cause oxidative darkening of the olives. (Preservation achieved by a,b,c & i)

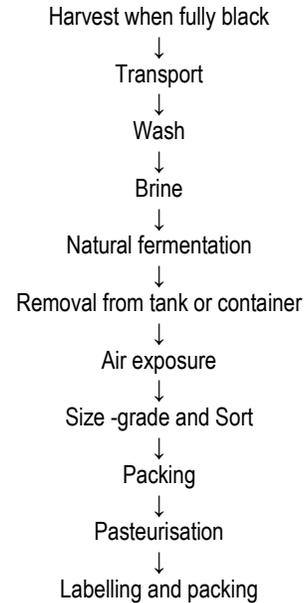


Black Table Olives

Naturally black olives in brine

Black olives are harvested and washed, then are placed directly in brine, where a natural fermentation occurs. (Preservation achieved by a, b & c). The methods for untreated "turning-colour" olives in brine and of aerobic fermentation also apply to black olives.

Naturally Black Olive Protocol

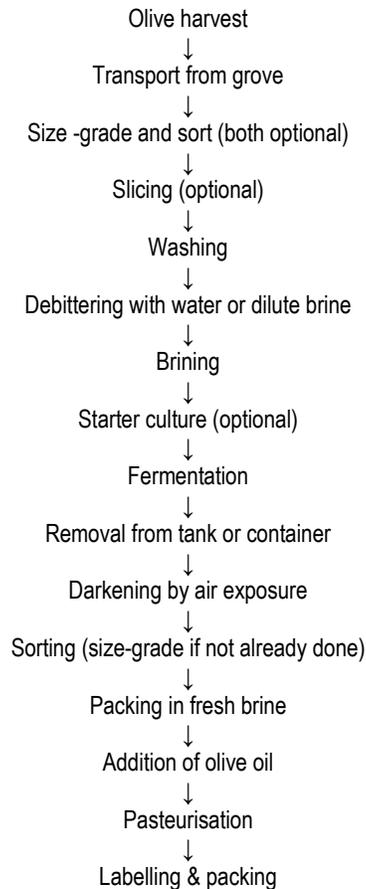


- This style of olive is often difficult to produce without spoilage occurring.
- The olives are harvested when fully black. (In Greece the olives may be harvested after being allowed to fall naturally on to nets spread on the ground).
- Washing. The olives should be washed in potable water to remove dust and possible bird or animal droppings. Washing is most efficient if carried out along a conveyor belt but changing the water in the tank or container containing olives is acceptable.
- Brining. Addition of 8% (80g/l) salt brine is desirable.
- The container is then sealed.
- The olives and brine will gradually equilibrate and the salt level will fall. Once the salt level falls below 6%, additional salt should be added by dissolving salt in some of the brine. Circulate the brine to ensure the salt level is uniform throughout the container. Serious spoilage will result if the salt level is low in parts of the container.
- The success of this type of fermentation depends on the natural microorganisms present. The fermentation is quite slow and may take one to two years to complete.

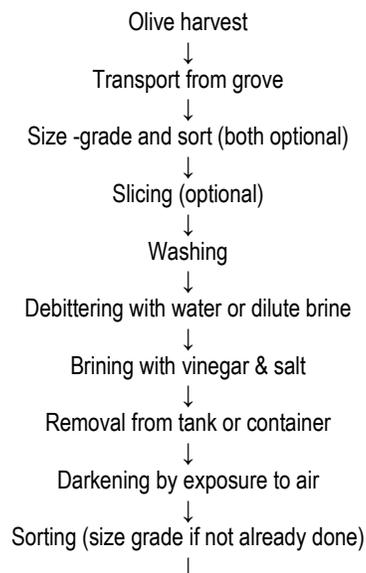
Kalamata olives

Two methods of processing.

Kalamata Protocol (Long method)



(Short Method)



Packing in fresh brine with additional vinegar if required



Aerobic fermentation of black olives. The method for aerobic fermentation of turning colour olives is also used for black and Kalamata olives.

Dried and semi-dried olives

Preservation achieved by a & d.

Olives are harvested when fully ripe.

The olives may be subjected to a brief lye treatment before being packed between layers of dry salt in crates or other suitable containers.

Alternatively the olives may be semi-dried by heating at low temperature (40 to 50°C) in an oven after blanching in hot water and soaking in a weak brine.

- Liquid is drawn out of the olives by osmosis and is allowed to drain away, the olive flesh becoming shrivelled but remaining moist.
- When the dehydration process is complete, the olives are washed free of any remaining solid salt, allowed to dry, coated with olive oil and stored in a cool dry place.

Critical processes and possible hazards

- Yeasts and moulds may be present in large numbers.
- Yeasts and moulds have been found to occur in higher numbers in olives that have undergone an initial lye treatment. The removal of the naturally occurring phenols and polyphenols from the olives by the lye reduces the natural inhibiting factors that resist the growth of yeast and moulds.



Infused olive oils

The introduction of flavouring materials to extra virgin olive oils has become widespread.

Critical points for Infused olive oils.

1. The introduction of herbs spices, plant material or flavours may also introduce pathogenic microorganisms.
2. In countries where the IOOC standard for olive oil is applied. Infused olive oils do not comply with the standard for virgin (extra) olive oil and cannot be labelled as such.
3. The Codex Alimentarius standard for olive oil (CODEX STAN 33-1981 (Rev. 1-1989) which is the IOOC standard does not permit the addition of food additives.
4. The Australian Olive Association (AOA) is currently working on the above standard being adopted in Australia. Currently infused Extra Virgin olive oils may be labelled as such in Australia.
5. The addition of garlic and perhaps other herbs and spices to edible oils is no longer permitted without prior pH adjustment of the vegetable material.
6. The following is reprinted from a current Food Science Australia Fact Sheet: -

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.

It is therefore essential that sufficient acid is added to the vegetable before it is mixed with oil so that any *C. botulinum* or other potentially dangerous bacteria can not grow.

Quality Assurance

Table olives in particular but also infused olive oils will always contain large populations of various microorganisms particularly at the end of initial processing. If the correct procedures have been followed, spoilage and pathogenic organisms should be absent or inhibited by the conditions i.e. salt level, final pH and acidity level.

Products exhibiting unusual odour, turbidity or surface growth should be tested for the presence of undesirable microorganisms.

Packaged table olives offered for sale should be pasteurised and tested microbiologically before being released for sale.

Testing of olives and olive oil can be carried out by:

**Institute of Medical and
Veterinary Science
Food and Environmental Laboratory
Frome Road, ADELAIDE SA**

**Postal Address: -
PO Box 14, Rundle Mall, SA 5000**

Phone 08 8222 3363 Fax 08 8222 3695

Microbiological standards recommended for table Olives and infused olive oil

No actual standards specific to table olives or infused olive oil exist at present.

Because table olives are sold in both bulk form in fermentation brine (unpasteurised) and in packages intended for retail sale (pasteurised or possibly unpasteurised) it is suggested that table olives and infused olive oil comply to the Food Standards Australia New Zealand (FSANZ) microbiological standard "Guidelines for the microbiological examination of ready – to – eat foods (December 2001) Reproduced in part below.

The complete standard may be obtained from the FSANZ website listed previously in this article

www.foodstandards.gov.au/mediapublications/guidelinesformicroi1306.cfm **sighted 21062005**

Categories of microbiological quality

Four categories of microbiological quality have been assigned based on standard plate counts, levels of indicator organisms and the number or presence of pathogens. These are satisfactory, marginal, unsatisfactory and potentially hazardous.

Satisfactory ñ results indicate good microbiological quality. No action required.

Marginal ñ results are borderline in that they are within limits of acceptable microbiological quality but may indicate possible hygiene problems in the preparation of the food. Action: Re-sampling may be appropriate. Premises that regularly yield borderline results should have their food handling controls investigated.

Unsatisfactory ñ results are outside of acceptable microbiological limits and are indicative of poor hygiene or food handling practices.

Action: Further sampling, including the sampling of other foods from the food premise may be required and an investigation undertaken to determine whether food handling controls and hygiene practices are adequate.

Potentially Hazardous ñ the levels in this range may cause food borne illness and immediate remedial action should be initiated.

Action: Consideration should be given to the withdrawal of any of the food still available for sale or distribution and, if applicable, recall action may be indicated. An investigation of food production or handling practices should be instigated to determine the source/cause of the problem so that remedial actions can commence.

Table 1. Guideline levels for determining the microbiological quality of ready-to-eat foods

Test	Microbiological Quality (CFU per gram)			
	Satisfactory	Marginal	Unsatisfactory	Potentially Hazardous
Standard Plate Count				
Level 1.	<10 ⁴	<10 ⁵	≥10 ⁵	
Level 2.	<10 ⁶	<10 ⁷	≥10 ⁷	
Level 3.	N/A	N/A	N/A	
Indicators				
<i>Enterobacteriaceae</i> *	<10 ²	10 ² -10 ⁴	≥10 ⁴	
<i>Escherichia coli</i>	<3	3- 100	≥100	**
Pathogens				
Coagulase +ve staphylococci	<10 ²	10 ² -10 ³	10 ³ -10 ⁴	≥10 ⁴ SET +ve
<i>Clostridium perfringens</i>	<10 ²	10 ² -10 ³	10 ³ -10 ⁴	≥10 ⁴
<i>Bacillus cereus</i> and other pathogenic <i>Bacillus</i> spp	<10 ²	10 ² -10 ³	10 ³ -10 ⁴	≥10 ⁴
<i>Vibrio parahaemolyticus</i> #	<3	<3 -10 ²	10 ² -10 ⁴	≥10 ⁴
<i>Campylobacter</i> spp	not detected in 25g			detected
<i>Salmonella</i> spp	not detected in 25g			detected
<i>Listeria monocytogenes</i>	not detected in 25g	not detected but <10 ²		≥10 ² ##

* *Enterobacteriaceae* testing is not applicable to fresh fruits and vegetables or foods containing these.

** Pathogenic strains of *E. coli* should be absent.

V. parahaemolyticus should not be present in seafood that has been cooked. For ready to-eat seafood that is raw, a higher satisfactory level may be applied (<10² cfu/g)

The potentially hazardous level of *V. parahaemolyticus* relates to Kanagawa-positive strains.

Foods with a long shelf life stored under refrigeration should have no *L. monocytogenes* detected in 25g.

The detection of *L. monocytogenes* in ready-to-eat foods prepared specifically for "at risk" population groups (the elderly, immunocompromised and infants) should also be considered as potentially hazardous.

N/A nSPC testing not applicable. This applies to foods such as fresh fruits and vegetables (including salad vegetables), fermented foods and foods incorporating these (such as sandwiches and filled rolls) **Copyright Food Standards Australia New Zealand reproduced by permission**

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A Garrido Fernandez, M. J. Fernandez Diez & M. R. Adams. ISBN 0 41271810 3. Aspen Publishers (USA) (Approx \$270).
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IOOC Publication via Australian Olive Association (AOA) – www.australianolives.com.au
- Producing Table Olives
ISBN 9780643092037. Landlinks Press, Collingwood Victoria or AOA – www.australianolives.com.au

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