Food Safety for Table Olives

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Potential Problems in Table Olive Processing

Stage	Physical	Chemical	Microbiological
Preprocessing	yes	 Non-potable water Agricultural Chemicals Contamination 	 Natural Biota + Potential Pathogens & spoilage organisms
Processing	yes	 Non-potable water Non-food grade inputs Poorly controlled processing Production of biogenic amines and toxins 	 Natural biota + Potential pathogens & spoilage organisms Contamination Addition of uncontrolled starter cultures Spoilage
Packaging	yes	 Poor cleaning of containers Inappropriate packaging solutions and methods 	 Cloudy brines Contamination Unfiltered fermentation brine Inadequate preservation
Preservation			 Inappropriate methods
Storage		Poor storage eg Temp	 Overgrowth of microbes

Table Olive Products must be Safe, Edible and Nutritious

For safe table olives attend to • GAP • GMP • GHP

Good Agricultural Practice Healthy olive trees Limited use of chemicals Use recommended rates **Appropriate harvesting Proper post harvest handling** Store olives 5-10°C Use quality olives – no defects

GMP

- Clear Processes
- Trained workers
- Adequate plant
 Potable water
- Food grade inputs
- Documented procedures
- Appropriate equipment food grade
- Suitable storage of olive products away from heat and light
- Traceable records
- Defined recall system

GHP

Ensure good personnel hygiene Report – vomiting, diarrhoea, fever, open sores Avoid direct contact with olives Ensure easily accessible hand washing facilities are as Undertake effective cleaning of processing plant Prevent cross contamination Use potable water for all cleaning, processing & packaging Treat non-potable water – filtration, UV radiation, heat Implement a cleaning and sanitizing program - Use soaps and detergents for cleaning Use sanitizers and disinfectants for antimicrobial control

General Processing Procedures

Olives enter processing line – prevent contamination

- Sort and remove damaged olives
- Rough size-grade the olives
- Wash olives with potable water removes contaminants

Processing Solution – check calculations

- Potable water note this requires regular changes
- Brine 6 -10% sodium chloride in potable water
- Lye solutions 1-2% sodium hydroxide hazardous chemical
- Prepare solutions in separate tanks then add to processing tanks

Olives placed into containers or tanks – clean and sanitized

- Variety process raw olives only one variety/tank
- Maturation state process raw olives one maturation stage/tank
- Add raw olives to tanks partially filled with processing solution to prevent bruising and pressure damage

Physical Hazards

- Foreign matter that may cause illness or injury
- Source of foreign matter
- accidental, poorly maintained facilities
- poorly managed procedures
- poor worker practices
- deliberate

Physical Contaminant	Source of Contaminant
Glass	Glass fragments - bottles, jars, light fittings, thermometers
Wood	Twigs, pieces of wood from olive orchard
Stones	Olive orchard, olive stones with destoned olives
Metal	Machinery – olive orchard, processing plant
Pests	Insects, rodents
Plastic	Olive orchard
Personal Items	Pens, buttons, jewelry

Chemical Hazards

A chemical hazard is any substance that can cause illness or injury due to immediate or long-term exposure when ingested or inhaled.

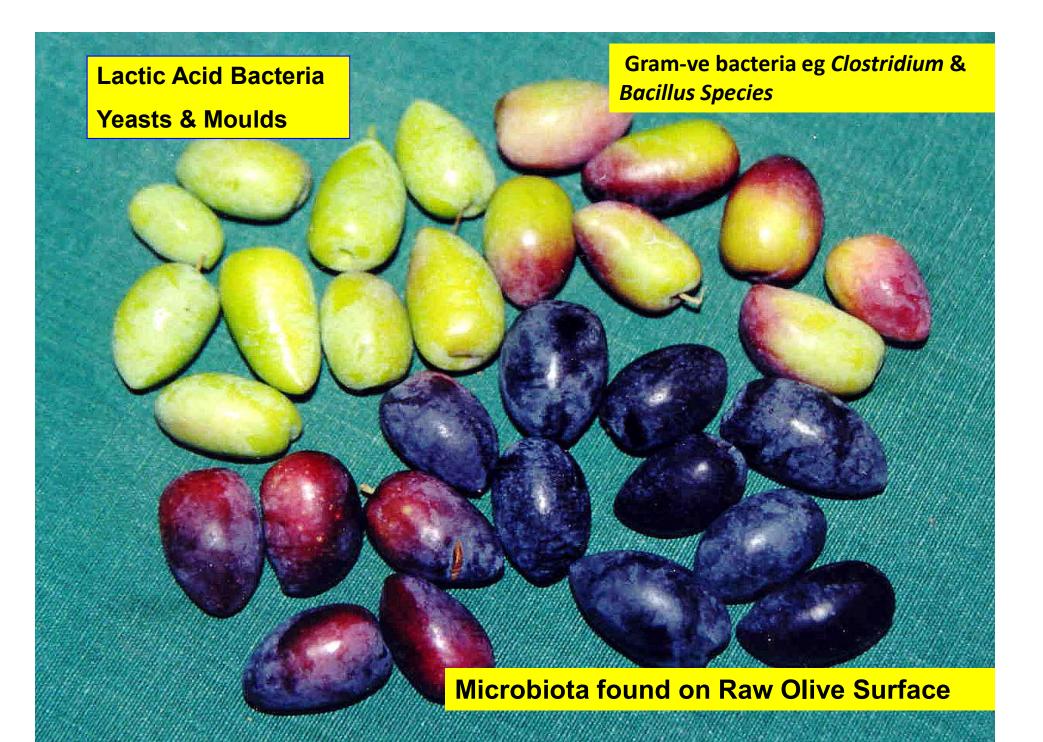
- Ensure workers are trained to handle chemicals
- Consider occupational health and safety of workers
- Use only food grade inputs
- Store and handle chemicals correctly
- Store chemicals away from foodstuffs & packaging
- Use only approved chemicals for cleaning & sanitizing
- Hire professionals for pest control
- Keep records and an inventory of all chemicals used

Food Allergies Relevant to Table Olive Products

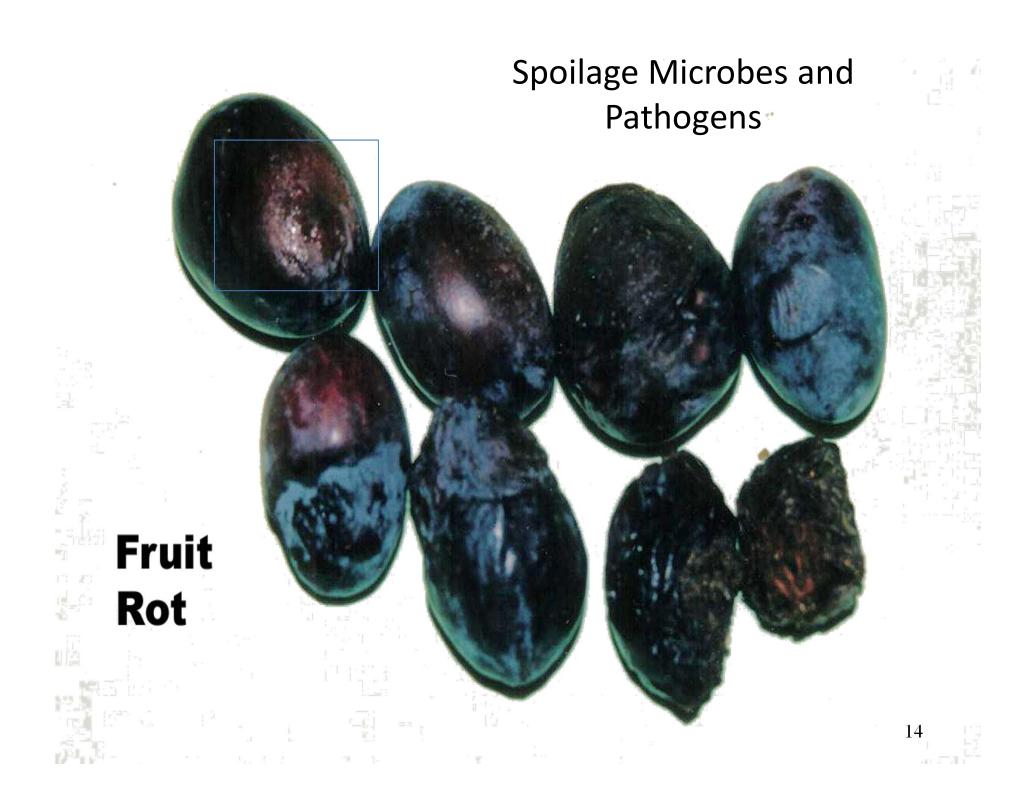
- Food allergy is when the immune system of a susceptible person reacts to an allergen, usually a protein.
- Symptoms can be mild to life threatening (anaphylaxis within a few seconds)

Foodstuff	Form	Table Olives
Nuts	All – especially peanuts and peanut oil	Stuffing - almonds, oil added to brine, nuts added to olive paste
Milk Products	Cheese	Stuffing eg fetta cheese
Eggs	Batter	Stuffed fried olives eg olive all' ascolana
Seafood	All	Anchovy – stuffing, tapenade
Sesame	Sesame Seed	Olive marinades
Wine	Processing aids/additives	Olive marinades
Soy	Soy Sauce	Olive marinades
Glutamates ?	MSG	Olive marinades





Sunburnt Verdale – Damaged Skin



Damaged Olives - Through Harvesting



Processing Method and Potential Problems with Table Olives

Table Olive Type or Style	Processing Method	Fermentative Microorganisms	Potential Problems
Greek Style Black Kalamata Style Gaeta Style	Mostly Anaerobic Fermentation (Aerobic Fermentation)	Lactic acid bacteria and yeasts > 8% salt mainly yeast	Food Poisoning Spoilage
Sicilian Style Green 1 Ligurian Style (mixed maturation states)	Anaerobic Fermentation in Brine	Lactic acid bacteria and yeasts > 8% salt mainly yeast	Food Poisoning Spoilage
Thassos (Huma &Botija Peruvian Olives)	Naturally Dried	None	Rancidity
Throumbes	Salt Dried	None	Rancidity, mould
Air Dried Green or Black Olives	Air + Heat Dried (40 ^o C)	None	Over Heating Rancidity
Ferrandina Style	Blanched + Salted + Oven Dried (50 ^o C	None	Over Heating Rancidity
Picholine Style (IOC) Sicilian Style 2	Lye Treated No Fermentation	None	Food Poisoning Spoilage
Spanish Style Green	Lye treated + Fermentation	Mainly lactic acid bacteria	Food Poisoning Spoilage

Note no mould growth

Keep headspace to a minimum

Fermented Kalamata Olives in a Food Grade Plastic Barrel

Common Moulds • Penicilin • Aspergillus

Olive Fermentation Contaminated with Mould

Jumbo Kalamata TC Fermented in Brine





Heat dried black olives with fennel seed and olive oil

Black Ripe Olives Multiple lye treatments Oxidation Iron salts Black olives result Low salt – High pH Sterilized

Raw Cracked Olives Multiple Changes of Potable Water

Water Cured Olives Placed In Brine

Lose green colour and many nutrients Lack flavour washed out Prone to spoilage

Spanish Style Green Olive Stuffed with Pimento

Picholine Style Olives (Bright Green)

Colouring of Green Olives by copper compounds

- copper in olives
- copper chemicals
- Deliberate Additions
- Copper phaeophytin (E141i)
- Copper chlorophyllin (E141ii)
- Copper sulphate
- Colouring olives is not
- allowed by EU
- Adulteration 85,000 Tonnes
- Copper sulphate unsafe
- E141ii relatively safe



Potential Microbiological Hazards

Salmonella - animal faeces, human carriers Campylobacter – animal faeces, raw milk, water Enterobacteriaceae eg Escherechia coli - water, animal faeces

Staph aureus - human skin, nasal passages, sores

Clostridium perfringens - soil, dust, air, water

Clostridium botulinum - soil, animals, honey

Bacillus cereus - soil, dust

Listeria monocytogenes - animals, insects, soil, raw milk + products eg cheese

Viruses

Parasites

- Giardia, contaminated food and water

Cryptosporidium – faeces/waterborne disease

Potential Food Poisoning – can occur with many foodstuffs

Pathogen T=Toxin	Appearance of Symptoms	Period of Illness	Comments/Symptoms N=nausea, V=vomiting, F=fever, C=cramps
Salmonella T	8-72 hours	2-5 days	N V F C diarhhoea (blood)
Listeria T	Within 3 weeks but up to 70 days		Risk – immuno-compromised preexisting disease, elderly & pregnancy (fetal problems)
Campylobacter T	2-5 days	2-10 days	Diarrhea, F C
<i>E coli</i> O157:H7 T	3-4 days	7 days	N V C pain, diarrhea (blood)
Clostridium botulinum <mark>T</mark>	18-36 hours	Potentially lethal	Blurred vision, dry mouth, weakness, muscle paralysis, swallowing & breathing problems
Clostridium perfringens T	12 hours	Few days	Diarrhea, C
Staphylococcal T	30 mins to 8 hours	One day	Diarrhea, C, pain, dehydration
Bacillus cereus T	Diarrhoea 6-15 hours Nausea/Vomiting 30 mins – 6 hours	One day	Two types of symptoms - Diarrhoea Nausea & Vomiting
Novovirus Rotavirus	1-2 days	1-6 days	Diarrhoea, C, N, V, Joint and muscle pain

Some Reported Table Olive Problems

Compound or Microorganisms detected	Hazard	Microorganism
Histamine	Biogenic Amine	Spoilage Bacteria
Putrescine	Biogenic Amine	Spoilage Bacteria
Cadaverine	Biogenic Amine	Spoilage Bacteria
Tyramine	Biogenic Amine	Spoilage Bacteria
Ochratoxin	Mycotoxin	Mould
Citrinin	Mycotoxin	Mould
Aflatoxin B	Mycotoxin	Mould
Listeria monocytogenes	Pathogen (Toxin)	Pathogenic Bacterium
Staphylococcus sp	Pathogen (Toxin)	Pathogenic Bacterium
Coliforms	Pathogen (Toxin)	Pathogenic Bacterium
Yersinia and Escherechia	Pathogen (Toxin)	Pathogenic Bacterium

Botulism

Clostridium botulinum

Suspected cases – usually symptoms (lab tests)

Recalls – lack of documentation or preservation method

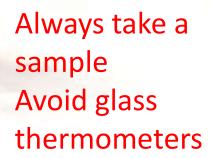
Reported	Product	Country	Cases	Comment
1920s	Black Ripe Olives	USA	28 deaths	Inadequate sterilization
1992	Black Olives	Italy	5 with 0 deaths	Incorrect storage after opening
2005	Green Olives	Italy	16 with 0 deaths	Locally harvested olives soaked in salt water for 35 days pH 6.2
2008	Black Olives	Turkey	8 with 0 deaths	Home prepared pH 5 Dutch Tourists
2011	Green Olive Paste	France	9 with 0 deaths	Inadequate heat treatment Home made
2011	Olives stuffed with almonds	Finland	2 with 1 death	Incorrect manufacture by producer
2012	Green Olives	England	1 with 0 death	Olympic games

Temperature and Table Olive Processing

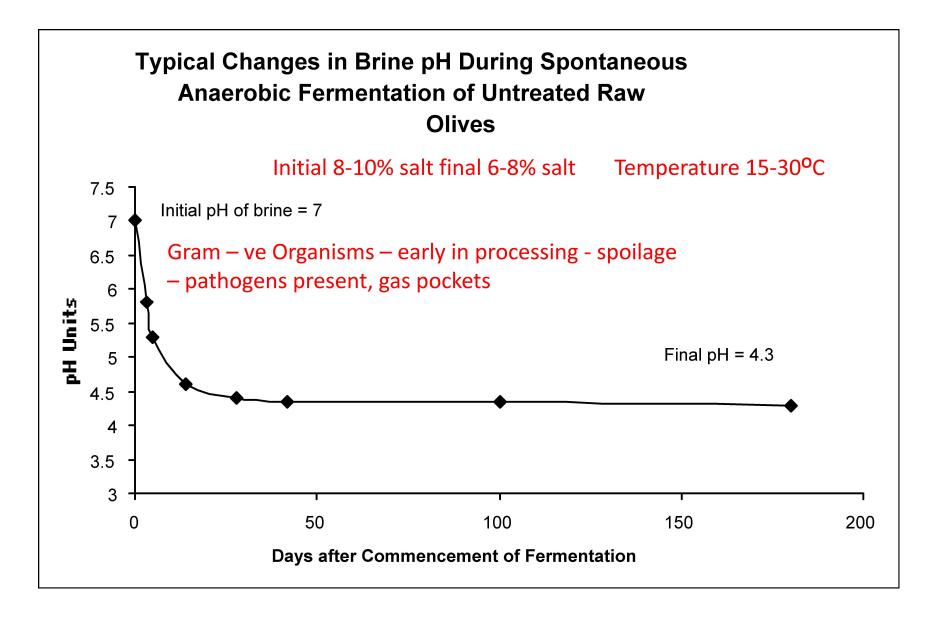
- Optimum for fermentation 15 30°C use digital thermometer
- High temperatures
- Can lead to anomalous fermentation
- Heat drying of olives 50°C (prolonged high temperatures can cook olives)
- Pasteurisation (Approx 80^oC) kills most microorganisms
- Steam sterilization (121°C) destroys microorganisms and spores
- Low temperatures
- Retards activity of most microorganisms but not *Listeria monocytogenes*
- Refrigeration increases shelf life
- Slows olive processing activity
- Pathogenic and non pathogenic bacteria are mesophilic with a maximum temperature tolerance of 35-50°C
- Spore forming bacteria from soil and water are thermophilic with a maximum temperature tolerance of 70-90°C

Always take a sample

Salt Refractometer to Measure Brine Salt Levels



Measuring Brine pH



Monitor pH – daily, weekly, monthly Monitor salt – weekly then monthly

Gas Pockets

Manzanilla Olives with Gas Pockets

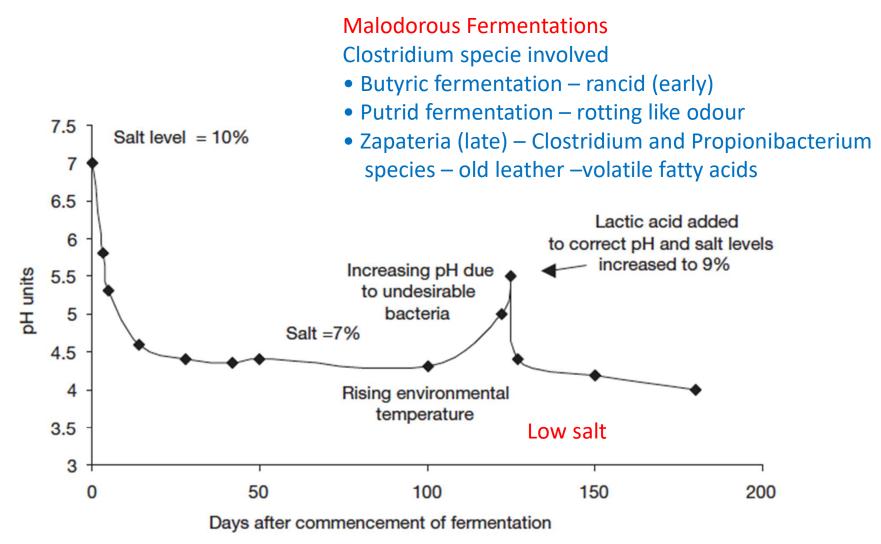


Figure 5.21 Possible pattern for undesirable bacterial activity during brine fermentation of table olives causing an increase in brine pH.

Gas Pocket

Gas Pocket

Fissure

Pressure Marks

Yeast Spots

Table Olive Processing Problems

Olive Preservation – Water Activity

Aw of water = 1 and will support growth of microorganisms

- Reduced Aw (Water Activity) restricts microorganism growth
- Salt brine adding salt to water reduces Aw
- Dehydrated olives salt, heat, air dry less water

Aw less than 0.9 most bacteria inhibited Aw less than 0.8 most yeasts inhibited Aw less than 0.7 most fungi inhibited Aw 0.95 to 0.9 have a salt range of 7-12% NaCl

 Aw 0.95 - Pseudomonas, Bacillus, Clostridium perfringens, and some yeasts inhibited
 Aw 0.90 - Limit of growth for bacteria eg Clostridium botulinum, Salmonella, Lactobacillus, some yeasts and fungi inhibited
 For dried olives - 30% loss of weight gives a satisfactory Aw

Olive Preservation – Acidity

- Each microorganism operates at an optimal pH
- Microorganisms flourish at around neutral pH 7 (neutral)
- Lowering olive pH inhibits pathogens and food poisoning organisms
- Below pH 4.6 bacterial spoilage resisted
- Olives with a pH of 4.6 or less are a high acid food and are less prone to microbial problems
- Olives with a pH greater than 4.6 are a low acid food and are more prone to microbial problems

Ideal preservation conditions for table olives are a brine:

- pH of 4.3 or less
- Salt 6% w/v
- Total free acid calculated as lactic acid is 0.3% or more

Acidity is determined by titration and expressed as % Lactic Acid pH is measured with a pH meter, and salt levels with a refractometer

Olive Preparation	Preservation Method	Minimum % Sodium Chloride	Maximum pH	Minimum Lactic Acid % Equivalent (acid capacity)
Treated (Lye)	Specific Chemical Characteristics or Modified Atmosphere	5	4	0.5
	Preservative or Refrigerated (4-7°C)	4	4	0.4
	Pasteurization 70-80°C or Sterilization	GMP eg 2-3%	4.3	GMP (to taste)
Natural Olives	Specific Chemical Characteristics or Modified Atmosphere	6	4.3	0.3
	Preservative or Refrigerated (4-7 ^o C)	6	4.3	0.3
	Pasteurization 70-80°C or Sterilization	GMP eg 2-3%	4.3	GMP (to taste)
Dehydrated	Specific Chemical Characteristics or Modified Atmosphere	10	GMP rinse with vinegar, EVO	GMP
	Preservative or Refrigerated (4-7 ^o C)	10	GMP Rinse with sodium sorbate	GMP
	Pasteurization 70-80°C or Sterilization	GMP eg < than 10%	GMP	GMP

Preservation Method	Conditions	Comments
Specific Chemical Characteristics	Brine – High Salt + Low Acid	Covers all pathogens and spoilage organisms (Residual yeasts and Lactic Acid Bacteria may be present)
Modified Atmosphere	Vacuum, N ₂ , CO ₂ , N ₂ -CO ₂ -O ₂	Suitable for dried olives
Preservative	Specific Chemical Characteristics must be met. Add Na or K Sorbate (= Sorbic Acid 0.05% +Na or K Benzoate (= Benzoic Acid 0.1%) to brine	 Ensure flesh content stabilizes Shelf life of aromatized olives is around 3 months if not pasteurized
Refrigeration	4-7 ^o C	If Specific Chemical Characteristics are not met some pathogens & spoilage organism may grow
Pasteurization (includes pastes and tapenade)	80°C for 8-10 minutes (after container and contents reach 80°C) Do not hot pasteurize olives in plastic bags	Natural green olives can discolour Cold pressure - experimental Hot pack – reuse brine
Sterilization	121 ^o C for one hour Acrylamide (potential carcinogen) may form during processing	Black Ripe Olives in Low Salt (1-2%) + high pH

Thank You