BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Environmental Health Services

Food Issue

Notes from the Field

Risk assessment of smoked brined olives

Request received from:	Regional Health Authority
Date of request:	April 14, 2014
Issue (brief description):	Client wishes to smoke green olives and brine for sale – is there any risk in the proposed process?

Summary of search information

1. Internet sources: olive association sites
2. PubMed: "botulism" AND "olives", "foodborne illness" AND "olives"
3. Other: consult Encylopedia of Food Sciences and ICMSF texts

Background information

Olives (*Olea europaea*) are fruits grown on evergreen trees in Mediterranean climates – the fruits are known as drupes.[1] Olives are harvested for oil and for eating (table olives).[1] All olives contain a bitter glycoside, called oleuropein.[1] In table olives, to remove the bitter taste, this glycoside is either removed using an alkaline process in either Spanish method (e.g., Manzanilla olives) or American method (e.g. black canned table olives) or with an extended brining process in the Greek method (e.g. Calamata olives).[1] It is necessary to remove oleuropein, both for flavour, and because it breaks down into compounds that are inhibitory to the lactic acid bacteria, which are necessary for the fermentation process.[2]

Information about the food product and process: The client purchases green Castelvatrano and Cerignola olives. The brine for the olives contains water, salt, citric acid and lactic acid. No quantities for the brine recipe were declared but the pH range for the brine was stated to be between 4.0 and 4.2. The brine and olives are smoked separately for 90 min at 37.8°C (100°F), then combined and portioned out into impermeable food quality grade resealable oxygen impermeable poly "stand up pouches" (from Tenka Pak http://www.tenkapack.com/stand-up-pouches/). A letter of guarantee supplied by the company to the client states the bags are free of fungicide, preservatives, fumigants and BPA.

Castelvantrano and Cerignola olives are geographically named based on harvest location. Castelvantrano is in western Sicily and Cerignola is in Puglio, Italy. According to one internet source the Castelvantrano style olive undergoes a lye treatment for 12 hours, then it must be refrigerated or canned because it is not fermented.[3] This same source reports that Cerignola olives also received lye treatment, followed by fermentation in 9% brine for a minimum of four weeks, resulting in a pH of 4.2.[4] Table olives can be processed in several ways, shown in Figure 1.[5] The initial treatment of the olives may include one or more of the following: lye washing in dilute potassium or sodium hydroxide (1.8% to 2.5% lye) which is followed by repeated rinses in water; placement in brine; acid fermentation (in the 6 to 10% brine

solution); preservation by heat (e.g. canning of black table olives); preservation by pasteurization and reduced oxygen packaging (ROP); preservation by acidification (0.6% to 0.9% lactic acid in added to 7-8% storage brine); cold-storage; application of colour to olives (erythrosine, to impart red colour to Cerignola olives); and salt preservation for dried olives. [1,2,4,5]

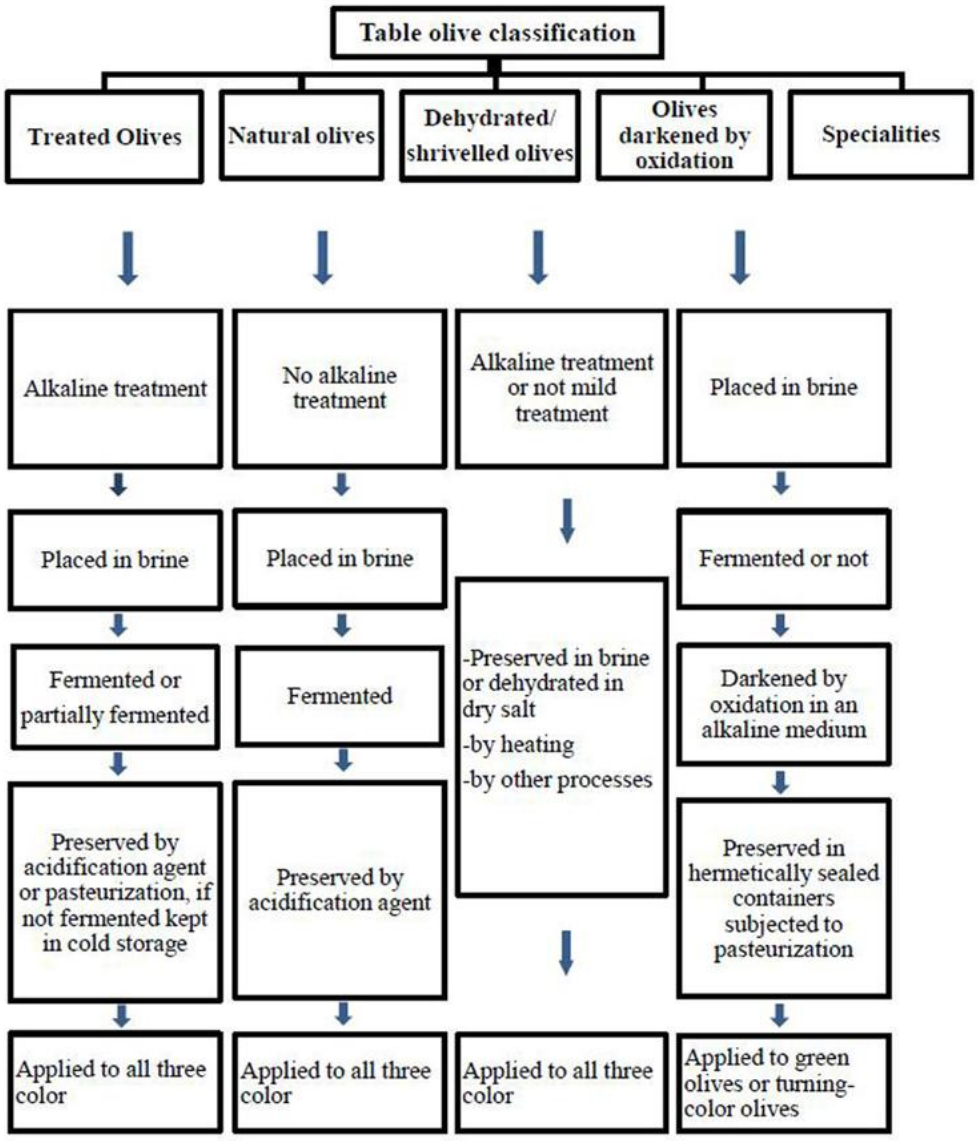

Figure 1 – Table olive treatments and classifications[5]

The client reports that 2 pH tests were conducted on the green olives after the brining process. One pH test was satisfactory, the value was pH=4.48 (Mar 17 batch); however, the second test on another batch

of olives was not satisfactory, the value was pH=4.7 (Mar 29 batch). Both batches of olives had the same water activity result (Aw=0.98) and satisfactory aerobic colony counts, further, no *E.coli*, *Staphylococcus aureus*, yeasts and moulds were found in the Mar 17 batch.

What are the risks associated with smoked olives in brine in oxygen impermeable packaging (ROP)?

The hazards of concern in this product include microbiological and chemical concerns.

Microbiological hazards: There have been several documented outbreaks of botulism related to improperly prepared olive food products. Olive paste caused nine botulinum illnesses in two families in France in 2011. The cause of this outbreak was traced to improper sterilisation practices by the artisanal producer.[6] In Finland (also in 2011), two people contracted foodborne botulism (one died) after consuming olives stuffed with almonds that were manufactured in Italy.[7] Green olives that were locally harvested and soaked in salt water for 35 days caused a restaurant outbreak in Italy in 2004 where 16 cases became ill.[8] The pH of olives tested from the same batch was 6.2. Another outbreak traced to black olives was linked to illness in eight Dutch tourists on a cruise in Turkey in 2008. These table olives were home prepared, and the pH measured 5.0.[9] Historically, botulinum outbreaks that caused many deaths from Californian black olives in the 1920's led to the first food recalls. The practice at that time was to boil briefly in glass jars, so the glass would not break.[10]

Other microbiological hazards of concern include *E. coli, C. perfringens* and *Staphylococcus aureus.* Other bacteria are also present during the fermentation period, such as lactic acid bacteria. However, properly fermented table olives (with a starter culture, or allowed to naturally ferment) did not demonstrate any residual *E. coli* or *C. perfringens* at the end of the fermentation period.[5] *S. aureus,* however, appeared to persist – likely because this organism is highly resistant to brine and salt. *S. aureus* can survive in water activities down to 0.85, or 25% w/w of salt.[11]

If lye is not properly removed from the olives (inadequate leaching), this can inhibit the acid fermentation, allowing spoilage by yeasts and coliforms.[2] Gassiness, cheesy odors, softening of the olive flesh, and white spots are all an indication that either the salt content in the acidified brine is too low, or excess alkali has interfered with the normal development of the lactic acid bacteria.[2] During the fermentation process, anaerobic conditions should be maintained to prevent growth of oxygen tolerant yeasts.[2]

Chemical hazards: It is not known if the "poly" pouches pose a chemical hazard? The client should ask the company to confirm the bags are made of polypropylene (or polyethylene or polycarbonate) and if they are stable or have been tested under mildly acidic conditions. The migration of chemicals in the plastic may make this product unsuitable for long-term storage of olives in an acidic brine solution.

Previous guidance on smoking of food products from British Columbia

There has been no guidance supplied specifically on olives (smoked or brined) from BCCDC in the past. However, guidance regarding smoking and packaging practices has been given for fish and meats. In a cold fermentation process (temperatures below 37°C or 100°F) the length of time the product is "out of

temperature control" is considered as a CCP for time. The client's plan to cold smoke for 90 minutes falls well within the control time period for other food products. Other processing steps should be limited to 6 hours or less at temperatures above 20°C. Cold storage and handling of olives at temperatures below 10°C (or lower) will slow the rate of any bacterial growth before the olives are placed back into acidified brine and refrigerated.

Guidance for packaging of products for which *C. botulinum* is a hazard is given by the federal Food and Drug Act (B27.002). This states that low-acid foods packed in a hermetically sealed container must be sterilized. With this food product, the stand-up pouch is impermeable to air; however, there is normal atmospheric air in the top of the package (not all air is removed from the pouch). As long as the food product is acidified (below a pH of 4.6), then the packaging would be suitable.

A nutrition facts table is required by the *Food and Drugs Act* as well (B.01.401). More information about this requirement can be obtained from CFIA.

Recommendations from BCCDC

We are relying on the information provided to assess the product safety. It is still unclear what type of processing the olives has undergone before it has reached the client. It appears from the place names given for the olive brands that the olives may or may not have undergone a lye wash and fermentation process. If the removal of the alkali lye and acid fermentation process was done correctly, we think that the olives should already be at an acidified pH? Given the uncertainty of the olive treatment before reaching the client we would recommend the following:

1. The client should provide a recipe that includes the amount (weight or volume) of ingredients so that an assessment of the percentage of salt and acidification agent in the brine can be made.
2. We would also recommend the client chart out their process (create a food flow diagram) and provide a food safety plan to identify any CCPs or control points.
3. The client should ask their olive supplier for further information about the product. If a specification sheet about this product could be provided that would be helpful. Has the product been assessed by the supplier for pH or absence of coliforms or *E. coli*? What is the salt content of the product? That may already exist in a nutritional facts table
4. The client should ask their stand-up pouch supplier for more information about the plastic. Is it suitable for long-term storage of acidic foods?
5. During preparation (handling and smoking) strict adherence to proper hand-washing and sanitation is recommended, as *S. aureus* is a very salt-tolerant organism.
6. Multiple hurdles for this product are recommended. The olives should be stored in acidified brine (below pH of 4.6) and refrigerated (below 4°C). To assess the process and safety of the product, we recommend a pH test be done on multiple batches. Periodic pH tests could also be done to assure that acidification is met.

7. We would recommend a product label, and that it contain a statement about refrigeration, such as "keep refrigerated". A use-by or best-before date is also advisable, along with the name and contact information (address) of the business. An additional requirement from federal agencies is a nutrition facts table.

References

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