

Appendix B

How Table Olives Prepared

Raw or fresh olives are naturally very bitter; to make them palatable, olives must be cured and fermented, thereby removing oleuropein, a bitter phenolic compound that can reach levels of 14% of dry matter in young olives. In addition to oleuropein, other phenolic compounds render freshly picked olives unpalatable and must also be removed or lowered in quantity through curing and fermentation. Generally speaking, phenolics reach their peak in young fruit and are converted as the fruit matures. Once ripening occurs the levels of phenolics sharply decline through their conversion to other organic products which renders some cultivars edible immediately.

The curing process may take from a few days, with lye, to a few months with brine or salt packing. With the exception of California style and salt cured olives, all methods of curing involve a major fermentation involving bacteria and yeast that is of equal importance to the final table olive product.

Traditional cures, using the natural microflora on the fruit to induce fermentation, lead to two important outcomes:

- the leaching out and breakdown of oleuropein and other unpalatable phenolic compounds, and
- the generation of favorable metabolites from bacteria and yeast, such as organic acids, probiotics, glycerol and esters, which affect the sensorial properties of the final table olives.

Of all the metabolites lactic acid is the most important as it acts as a natural preservative lowering the pH of the solution to make the final product more stable against the growth of unwanted pathogenic species. The result is table olives which will store with or without refrigeration, and thus lactic acid bacteria (LAB) dominated fermentations are generally considered the most suitable method of curing olives. Yeast dominated fermentations produce a different suite of metabolites which have fewer self-preservation characteristics and therefore acid corrected, often with citric acid, in the final processing stage to achieve microbial stability.

There are many types of preparations for table olives depending on local tastes and traditions. The most important commercial examples are:

Spanish (or Sevillian) **type** (Olives with fermentation). Most commonly applied to green olive preparation. Around 60% of all the world's table olives are produced with this method. Olives are soaked in lye (dilute NaOH, 2-4%) for 8–10 hours to hydrolyse the *oleuropein*. They are usually considered "treated" when the lye has penetrated two-thirds of the way into the fruit. They are then washed once or several times in water to remove the caustic solution and transferred to fermenting vessels full of brine at typical concentrations of 8-12% NaCl. The brine is changed on a regular basis to help remove the phenolic compounds. Once fermented, the olives are placed in fresh brine and acid corrected ready for market.

Sicilian (or Greek) **type**. (Olives with fermentation). Applied to green, semi-ripe and ripe olives. Almost identical the Spanish type fermentation process, however the lye treatment process is skipped and the olives are placed directly in fermentation vessels full of brine (8-12% NaCl). The brine is changed on a regular basis to help remove the phenolic compounds. As the caustic treatment is avoided, Lactic acid bacteria are only present in similar numbers to yeast and appear to be outcompeted by the abundant yeasts found on untreated olives. As there is very little acid produced by the yeast fermentation, acid (lactic, acetic, or citric acid) is often added to the fermentation stage to stabilize the process.

Turkish type. (Olives with minor fermentation). Applied only to ripe olives and usually produced in Morocco or Turkey and other eastern Mediterranean countries. Once picked, the olives are vigorously washed and packed in alternating layers with salt. The high concentrations of salt draw the moisture out of olives, dehydrating and shriveling them until they look somewhat analogous to a raisin. Once packed in salt, fermentation is minimal. Once cured, they are sold in their natural state without any additives.

Picholine or directly-brined type. (Olives with fermentation). Can be applied to green, semi-ripe or ripe preparations. Olives are soaked in lye typically for longer periods than Spanish style (e.g. 10–72 hours) until the solution has penetrated three-quarters of the way into the fruit. They are then washed and immediately brined and acid corrected with citric acid to achieve microbial stability. Fermentation still occurs carried out by acidogenic yeast and bacteria, but is more subdued than other methods. The brine is changed on a regular basis to help remove the phenolic compounds and a series of progressively stronger concentrations of NaCl are added until the product is fully stabilized and ready to be eaten.

Water-cured type. (Olives with fermentation). Can be applied to green, semi-ripe or ripe preparations. Olives are soaked in water or weak brine and this solution is changed on a daily basis for 10–14 days. The *oleuropein* is naturally dissolved and leached into the water and removed during a continual soak-wash cycle. Fermentation takes place during the water treatment stage and involves a mixed yeast/bacteria ecosystem. Sometimes, the olives are lightly cracked with a hammer or a stone to trigger fermentation and speed up the fermentation process. Once debittered the olives are brined to concentrations of 8-12% NaCl, acid corrected and ready to eat.

California or "artificial ripening" type. (Olives without fermentation). Applied to green and semi-ripe olives. Olives are placed in lye and soaked. Upon their removal they are washed in water injected with compressed air. This process is repeated several times until both oxygen and lye have soaked through to the pit. The repeated, saturated exposure to air oxidizes the skin and flesh of the fruit, turning it black in an artificial process that mimics natural ripening. Once fully oxidized or "blackened", they are brined and acid corrected ready for eating.