

# FDE 437

## FERMENTATION TECHNOLOGY

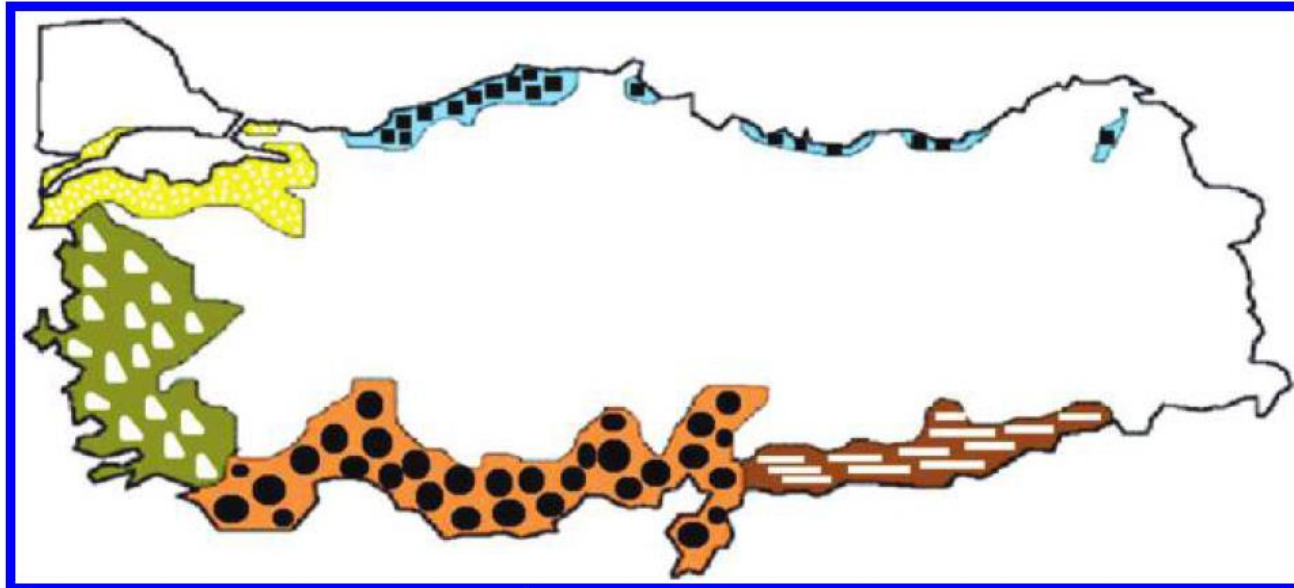
### Table Olive Production








- ▶ The olive tree (*Olea europaea* L.) is one of the most important trees in the world, and olive oil and table olives are consumed extensively as a basic ingredient of the Mediterranean diet.
- ▶ The fruit of olive tree (*Olea europaea* L.) is a drupe.
- ▶ It has a low sugar content of around 2.6%-6% and a high oil content of around 12%-30% depending on the maturity and variety.
- ▶ It has a bitter component called **oleuropein**. Therefore, it cannot be consumed after harvest due to the bitterness of oleuropein. Olive fruit has to be debittered with different techniques that depend on the region and the variety.

- ▶ Olives refer not only to the usually salty, acidic product known as **table olives**, but to the fruit from which they are made.
- ▶ The main use of raw olives is for olive oil.
- ▶ More than 90% of the total worldwide olive production is used **for oil** and only 7% to 10% are consumed **as table olives**.
- ▶ Table olives are important and popular fermented vegetable in the food industry, especially in Spain, Turkey, Italy, Egypt, Morocco, and Greece.
- ▶ **Turkey** lies in the second position in world table olive production after Spain.

# Olive production in Turkey



-  Aegean region
-  Marmara region
-  Mediterranean region
-  Southeastern anatolia region
-  Black sea region

## Main Varieties of Olives Cultivated in the Regions of Turkey

Region	Varieties
Aegean	Gemlik
	Memeli
	Memecik
	Ayvalık
	Domat
	Uslu
	Yamalak
Marmara	Çilli
	Manzanilla (Spanish variety)
	Gemlik
	Edremit
	Edincik Su
	Karamürsel Su
Mediterranean	Samanlı
	Tavşan Yüreği
	Sarı Ulak
	Kan Zeytini
Southeastern Anatolia	Gemlik
	Halhalı
	Kan Çelebi
	Eğriburun

Main varieties used in the production of table olives are **Gemlik**, **Memeli**, **Memecik**, **Edremit**, **Ayvalık**, and **Domat**.

- ▶ Table olives are classified according to the degree of ripeness of the fresh fruits as **green olives**, **turning color olives** and **black olives**.

The main processing types for table olive fermentation in the world are;

- ▶ green olives that are treated in a diluted lye solution,
- ▶ black olives in brine, and
- ▶ black olives in dry salt.
  
- ▶ The main processes used for **black olive production** in Turkey are Gemlik style in brine and dry salt.
  
- ▶ **For green olive production,** alkaline-treated, scratched, and cracked processes are used.
  
- ▶ Californian style is not commonly applied in Turkey.

- ▶ Treatment with a diluted lye solution (sodium hydroxide) is commonly used for debittering in some styles such as Spanish style and Californian style.
- ▶ But in some other styles, for example, processing of black olives in brine, olives are left to fermentation until they lose their bitterness without going through a lye treatment.
- ▶ Microorganisms play an important role in the production of table olives. The most relevant microbial groups involved in olive fermentations are **LAB** and with less extend **yeasts**.

# Composition of raw Material-olive fruit

- ▶ **Olive fruit** consists of water, oil, carbohydrates, protein, pectin, organic acids, and phenolic compounds.
- ▶ **Water** accounts for up to about 70% of its weight and serves as a solvent for the water-soluble constituents of the fruit.
- ▶ **Phenolics** are important due to the effects on the color of the olive and antimicrobial activity against a wide variety of microorganisms (including lactic acid bacteria). Moreover, **biophenols** show antioxidant and free radical scavenger ability, which are important for human health.
- ▶ The most important and certainly most abundant phenol in olives is **oleuropein**.



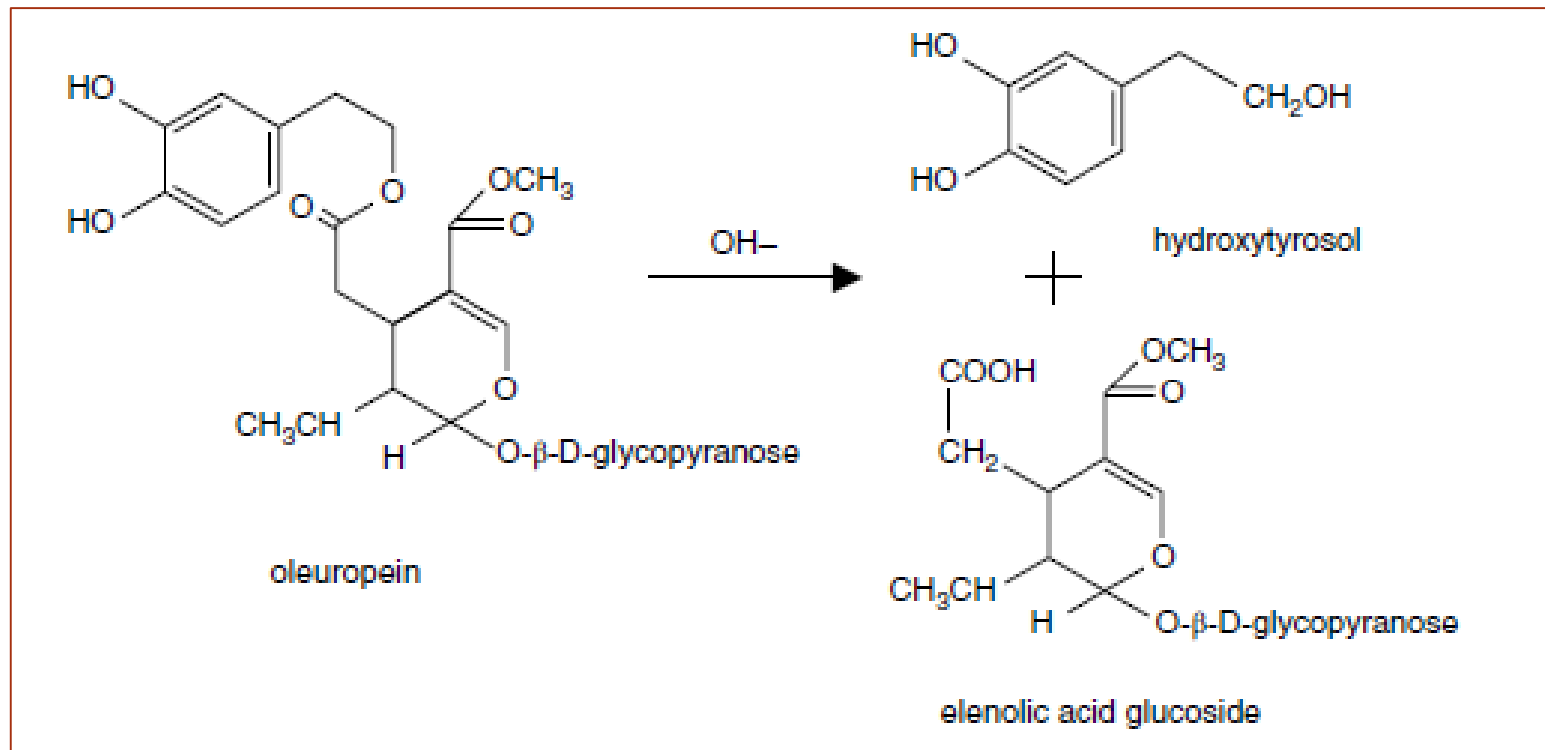
# Oleuropein

- ▶ The most important phenol in olives is **oleuropein**.
- ▶ Structurally, **oleuropein** is a glucoside ester of 3,4-dihydroxytyrosol and elenolic acid.
- ▶ Oleuropein is responsible for the natural bitterness of olive fruit.
- ▶ Some olive varieties can contain as much as 14% oleuropein (on a dry basis) during the early stages of growth, although most contain less than 6%.
- ▶ As the olives mature, the oleuropein concentration decreases, and at maturation, only about 1 mg to 2 mg per g of pulp is present. Still, between the remaining oleuropein and related derivatives, the olives are generally too bitter to consume.
- ▶ Thus, manufacturing processes for most olives, including some fermented varieties, include an enzyme-mediated step, or more commonly, a sodium hydroxide-treatment to hydrolyze and remove the bitter oleuropein fractions.

# Debittering process for table olives

- ▶ **Oleuropein** is responsible for the natural bitterness of olive fruit.
- ▶ Hydrolysis of the oleuropein to more simpler and less bitter compounds is obtained by olive processing.
- ▶ During debittering process, the glucoside oleuropein is chemically hydrolyzed and transformed into elenolic acid and hydroxytyrosol.
- ▶ Oleuropein can be hydrolyzed by alkaline, acid, and the enzyme glucosidase.
- ▶ By using the enzyme,  $\beta$ -glucosidase, oleuropein can be hydrolyzed into glucose and oleuropein aglycone, which further transforms to nonbitter metabolites.
- ▶ It was reported that using  $\beta$ -glucosidase prevents the loss of fermentable sugars during washing step, which is done after lye treatment, and enhances the lactic acid fermentation with resulting a favored end product.

# Alkaline hydrolysis of oleuropein



# Processing of Table Olives in Turkey

- ▶ The produced Turkish table olives are generally 70%-85% black and 15%-30% green and turning color olives.
- ▶ Before consumption, table olives will undergo some trade processings and grouped as untreated and processed table olives.
- ▶ **The untreated table olives** are processed without alkaline (lye) treatment by brining of olives to undergo complete or partial fermentation, brining of olives in dry salt, which is also known as *sele*, or removing of water of olives with suitable drying techniques.
- ▶ **The processed table olives** are processed after alkaline treatment by fermentation of olives after darkening by oxidation, removal of water from olives with suitable drying techniques, or brining of olives.
- ▶ It was notified that brine is prepared by drinkable water that is suitable for human consumption (Turkish Food Codex 2014).

## Main processing methods for table olive production in Turkey are;

- Untreated black olives in brine
- Gemlik style
- Dry-salted black olives
- Alkaline-treated green olives
- Scratched and cracked green olives