

# The table olive sector in Greece

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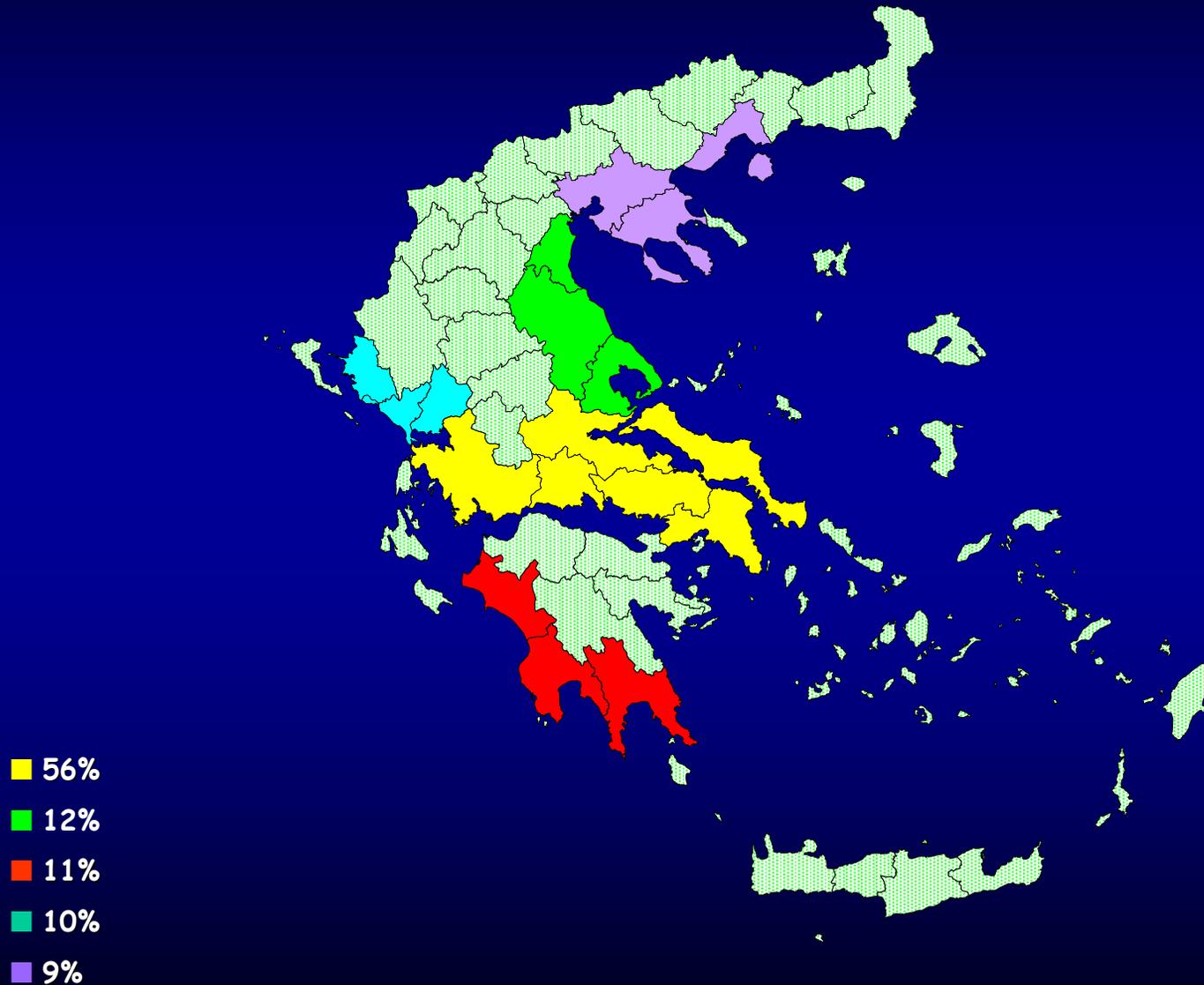


# Primary sector - Importance

- ✦ Table olive producers: 50.000-60.000
- ✦ Cultivated olive trees: 25-30.000.000
- ✦ Cultivated area: 153.000 ha
- ✦ Overall production: 200.000 tonnes
- ✦ Processed volume: 90-100.000 tonnes



# Table olive cultivation areas



# Table olive varieties- Conservolea



- Amounts to 51% of total olive production in Greece
- Average size: 180-200 fruits/kg
- Processed as Spanish-style green and naturally black olives
- Flesh-to-pit ratio: 8:1
- Oil content: 20-25% (w.b.)
- Fermentable material: 2-3% (w.b.)
- Similar to Manzanilla

# Table olive varieties- Halkidiki



- Amounts to 26% of total olive production in Greece
- Average size: 120-140 fruits/kg
- Processed as Spanish-style green olives
- Flesh-to-pit ratio: 10:1
- Oil content: 19-20% (w.b.)
- Similar to Gordal

# Table olive varieties- Kalamon



- Amounts to 20% of total olive production in Greece
- Average size: 220-240 fruits/kg
- Processed as naturally black olives
- Flesh-to-pit ratio: 8:1
- Oil content: 25% (w.b.)
- Fermentable material 3.1-3.5% (w.b.)

# Table olive varieties- Thassos



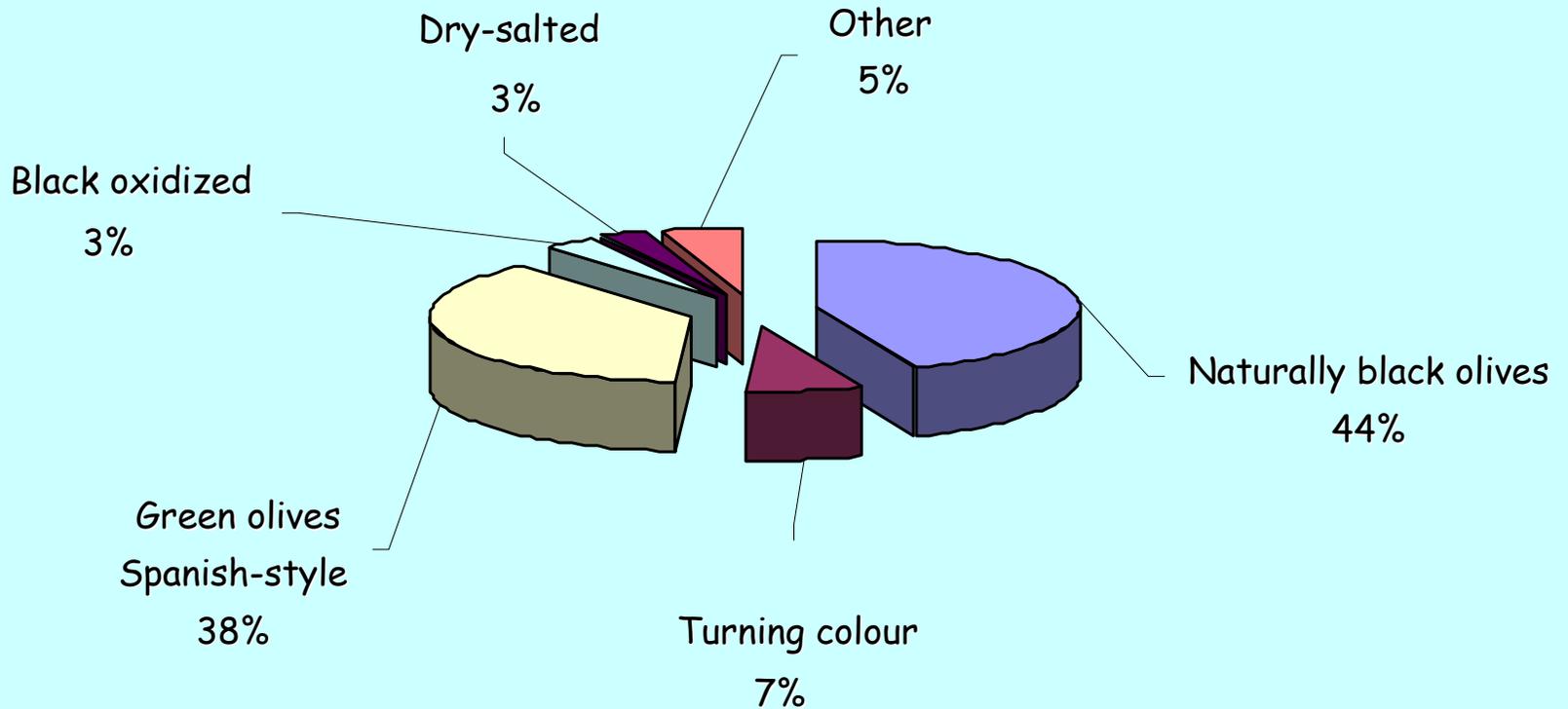
- Processed as dry-salted olives
- Flesh-to-pit ratio: 6:1
- Oil content: 26% (w.b.)
- Fermentable material 3.5% (w.b.)
- Limited interest in the international market
- Consumed locally

# Protected Destination of Origin (PDO) table olives

- Kalamata olives
- Conservolea Amfissa
- Conservolea Arta
- Conservolea Atalanti
- Conservolea Rovies
- Conservolea Stylida
- Conservolea Pilion, Volos
- Thrubolea Thassos
- Thrubolea Chios
- Thrubolea Ambadias, Rethymno, Crete



# Production of different types of table olives



# Table olive processing

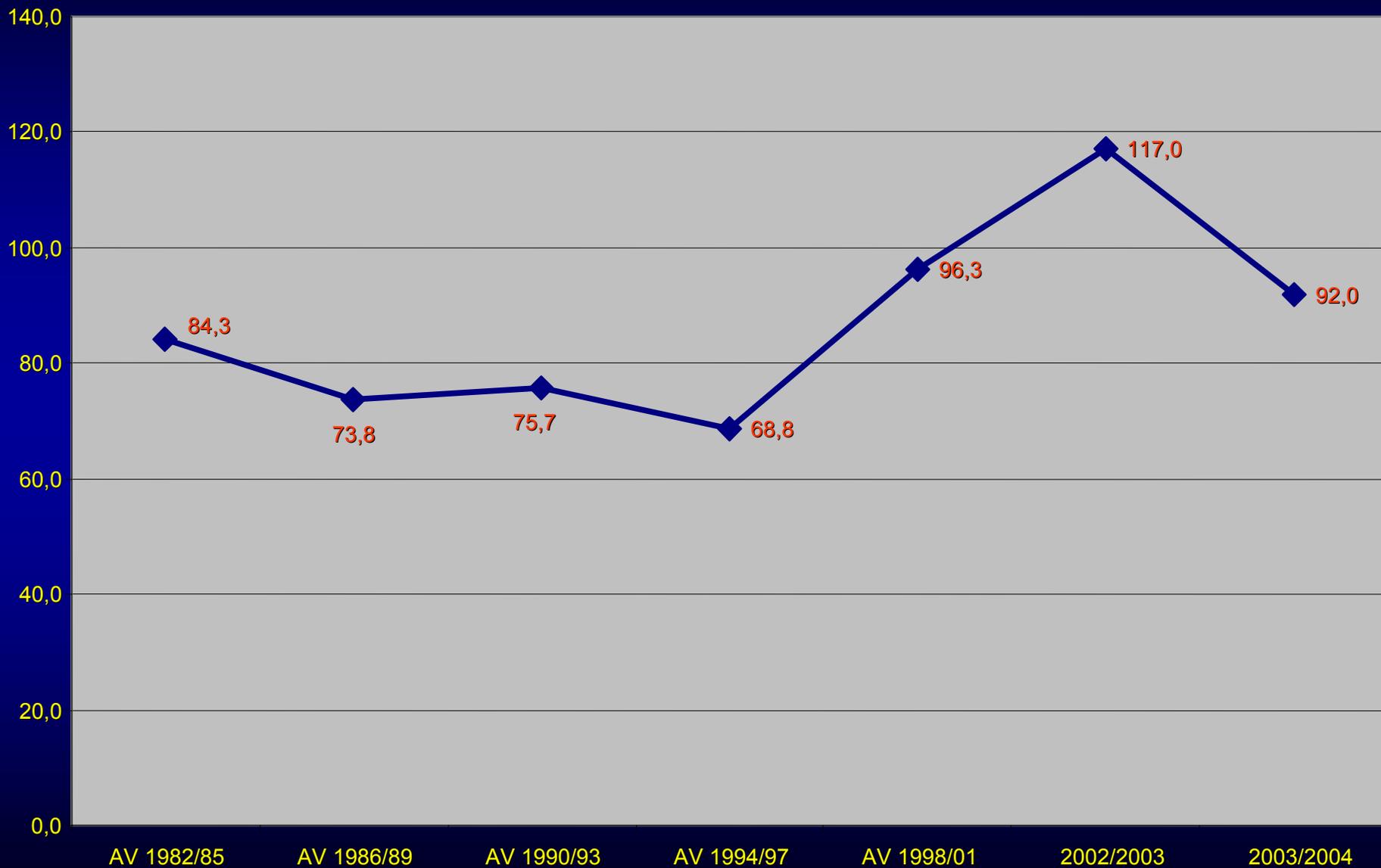
Table olive processing takes place in:

- Small-scale farmers' installations
- Cooperative owned installations (20)
- SMEs (60)

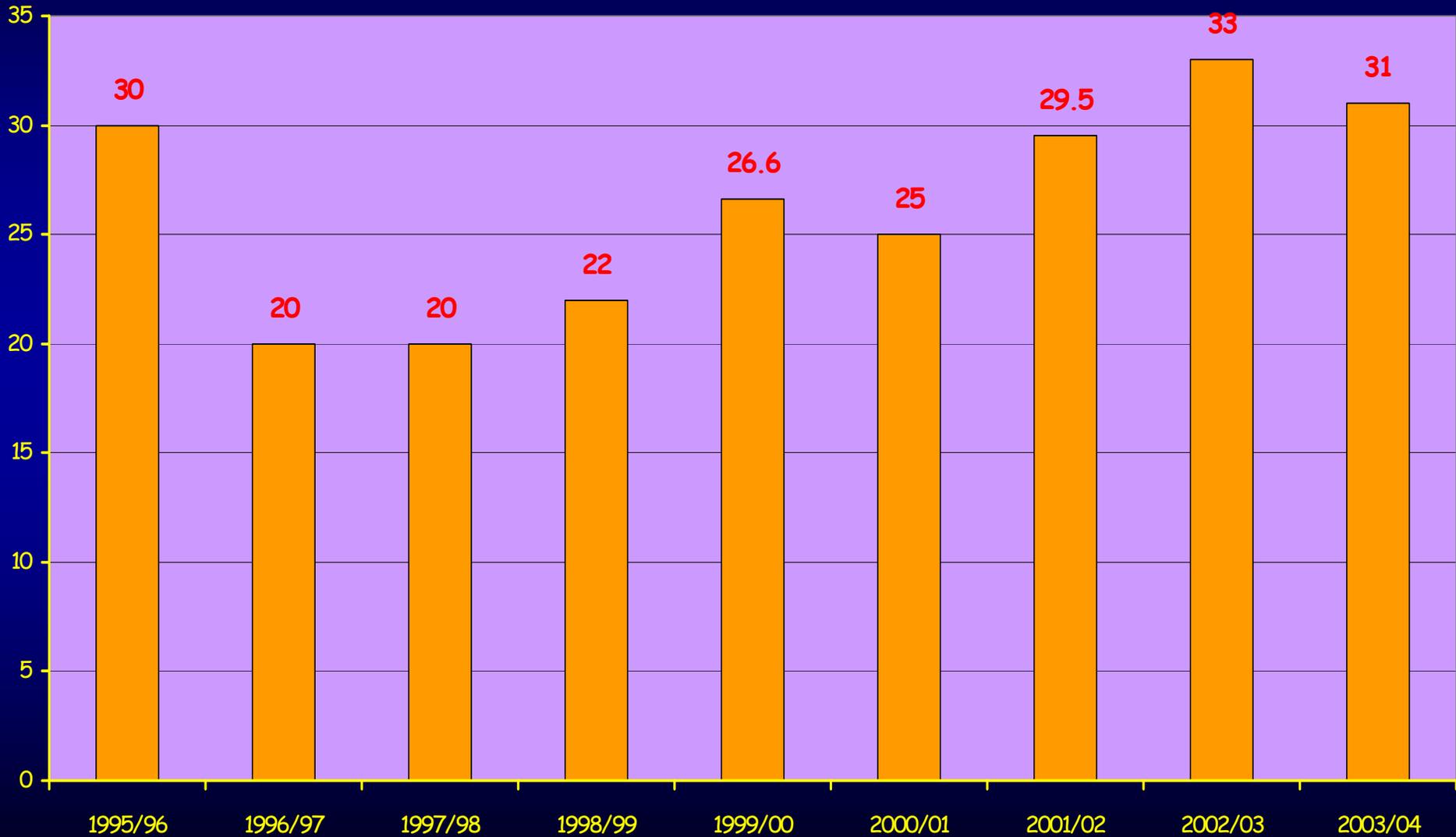
Overall capacity: 100-110.000 tonnes

SMEs with exporting orientation are organised in the Panhellenic Association of Table Olive Producers, Packers and Exporters (PEMETE) to support the product in domestic and international market

# Table olive production in Greece, 1982-2004 (x1000 tonnes)



# Table olive consumption in Greece, 1995-2004 (x1000 tonnes)



# Table olive consumption characteristics

## Consumers preference:

- 65-70% naturally black olives
- 20% green olives Spanish-style
- 10-15% other types (e.g. dry-salted olives)

## Demand for table olives

- Urban areas: 229-338 gr/month/household
- Rural areas: 350 gr/month/household

The value of domestic market was estimated to € 80 million in 2003/04

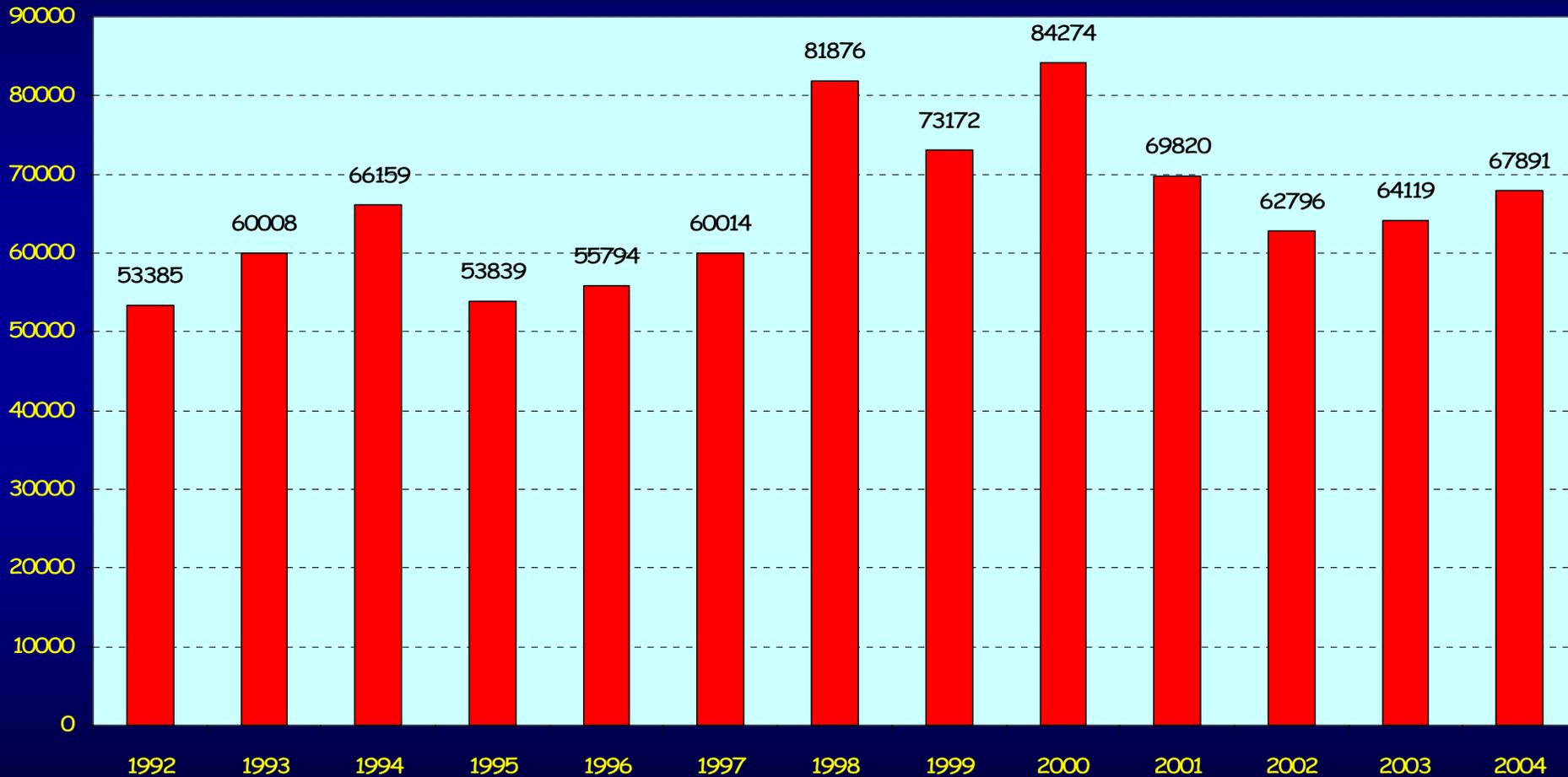
# Table olive exports



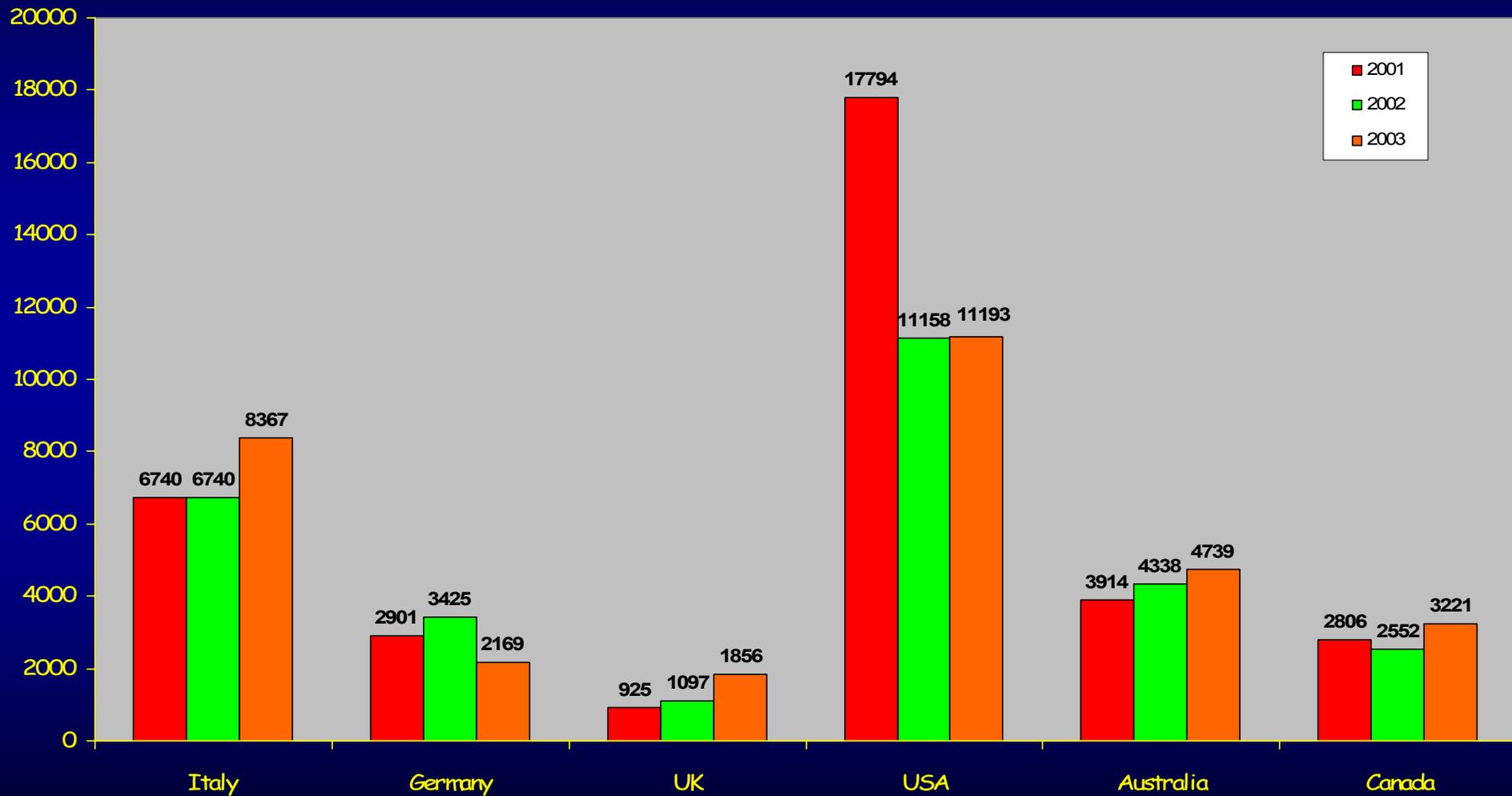
- The main volume of table olives is exported "in bulk" in large containers
- Exports of 2<sup>nd</sup> processing (value added) products are limited



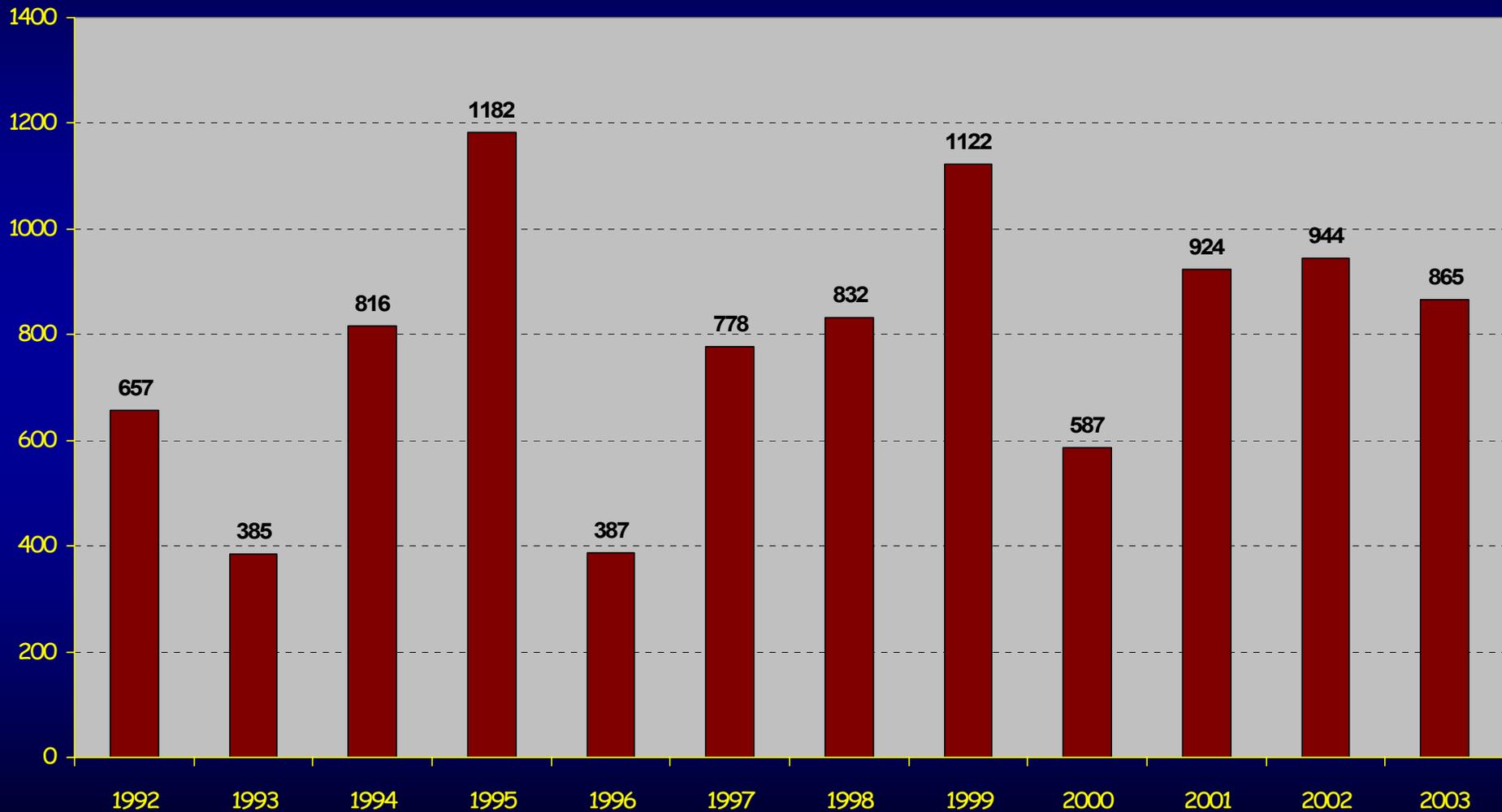
# Table olive exports, 1992-2004 (tonnes)



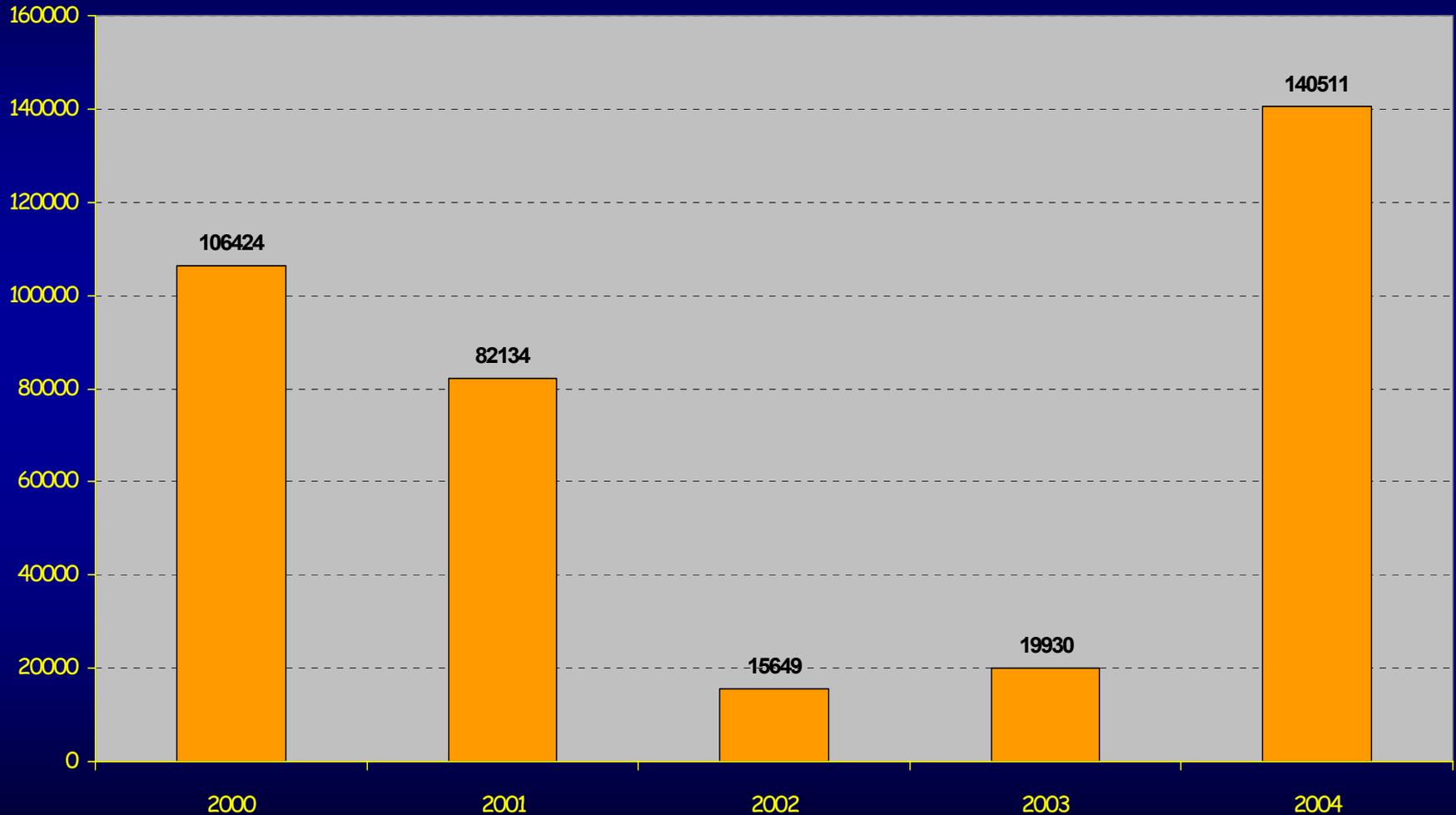
# Table olive exports per country, 2001-2003 (tonnes)



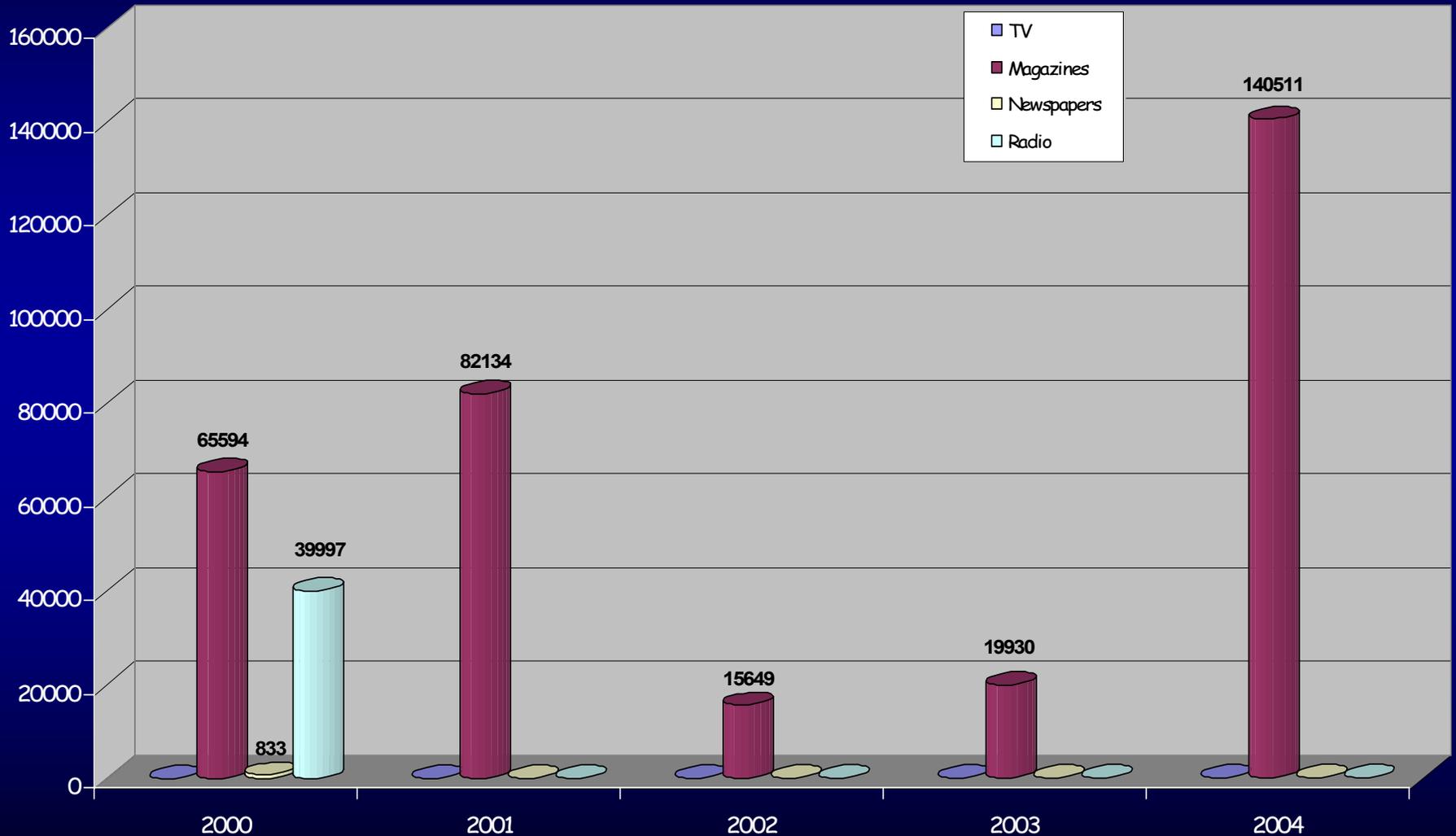
# Table olive imports, 1992-2003 (tonnes)



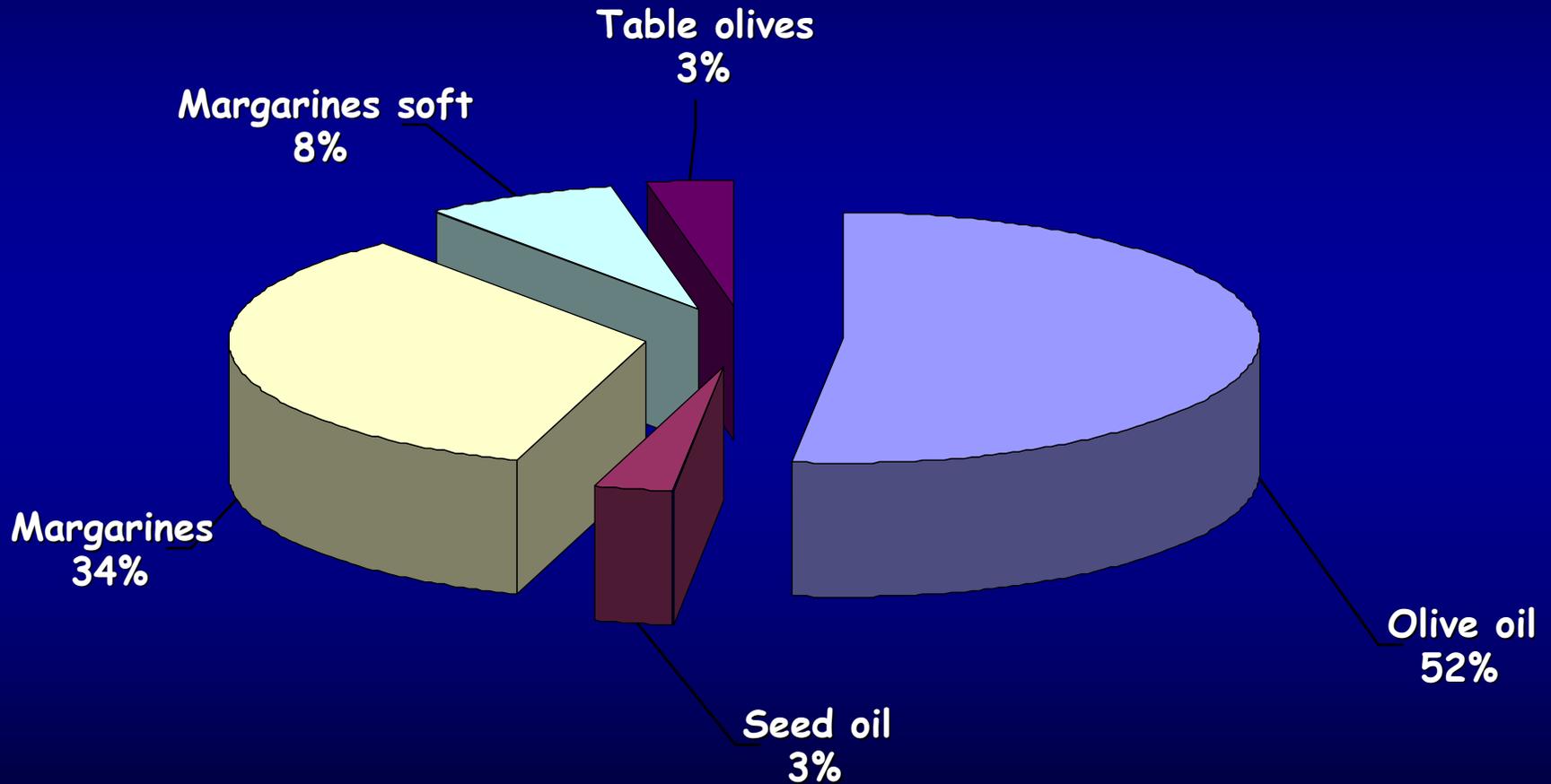
# Advertising expenditure, 2000-2004 (€)



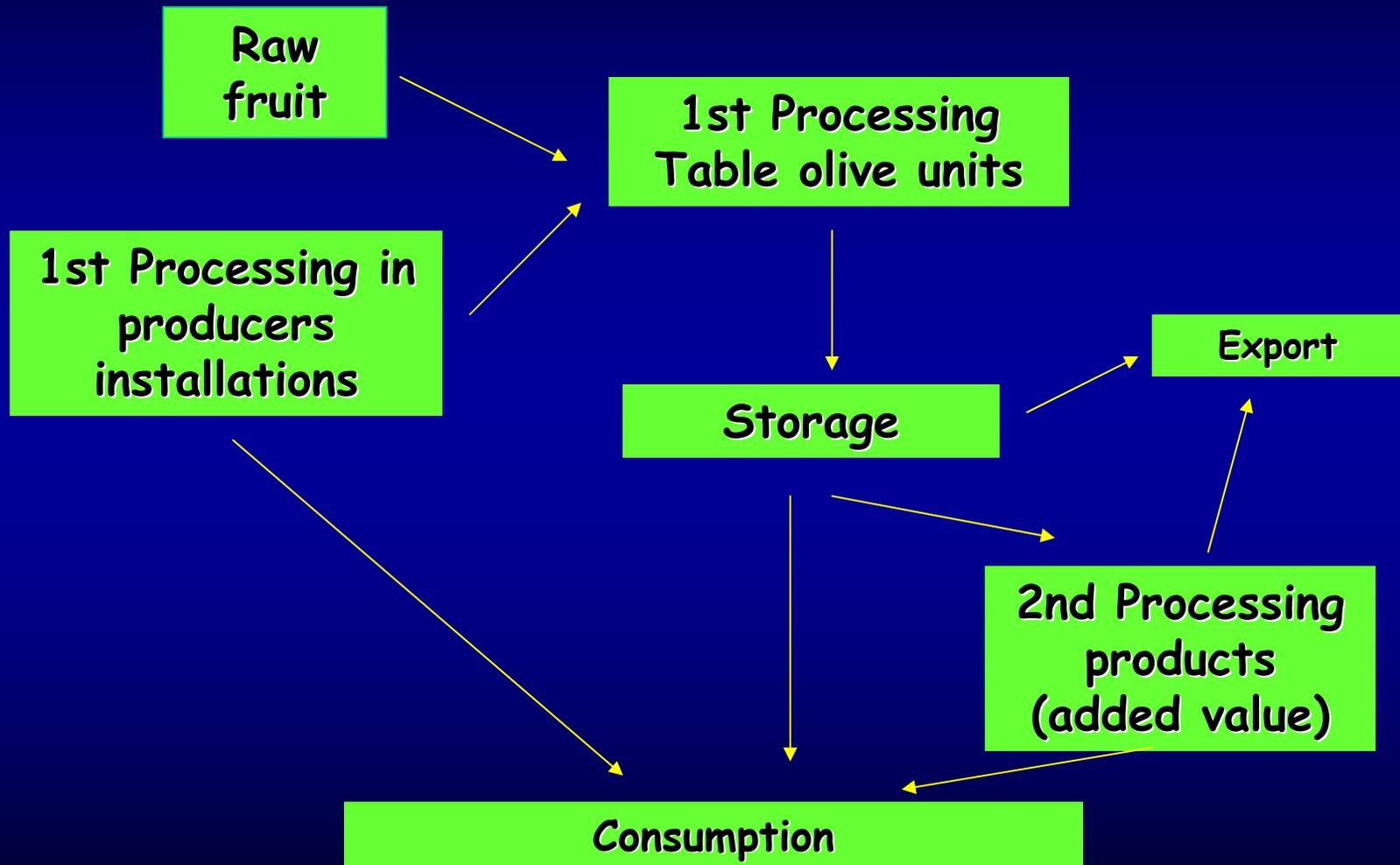
# Distribution of advertising expenditure, 2000-2004 (€)



# Advertising expenditure of table olives compared to other products



# Table olives - from the farm to the consumer



# Table olive marketing in Greece



**The consumption of packaged and standardized products in Greece is generally low (<10%)**

# Table olive marketing in Greece



## Quality control of table olives in Greece

- Ministry for Rural Development and Food, based on the Presidential Decree 221/79 "*...for standardization, packaging and quality control of table olives destined for exportation*"
- Trade regulation of the International Olive Oil Council published in 1980 "*Unified Qualitative Standard Applying to Table Olives in International Trade*"
- Table olives destined for the domestic market are inspected by EFET (Food Inspection Authority)

# Untreated black olives in brine

## (Greek-style table olives)

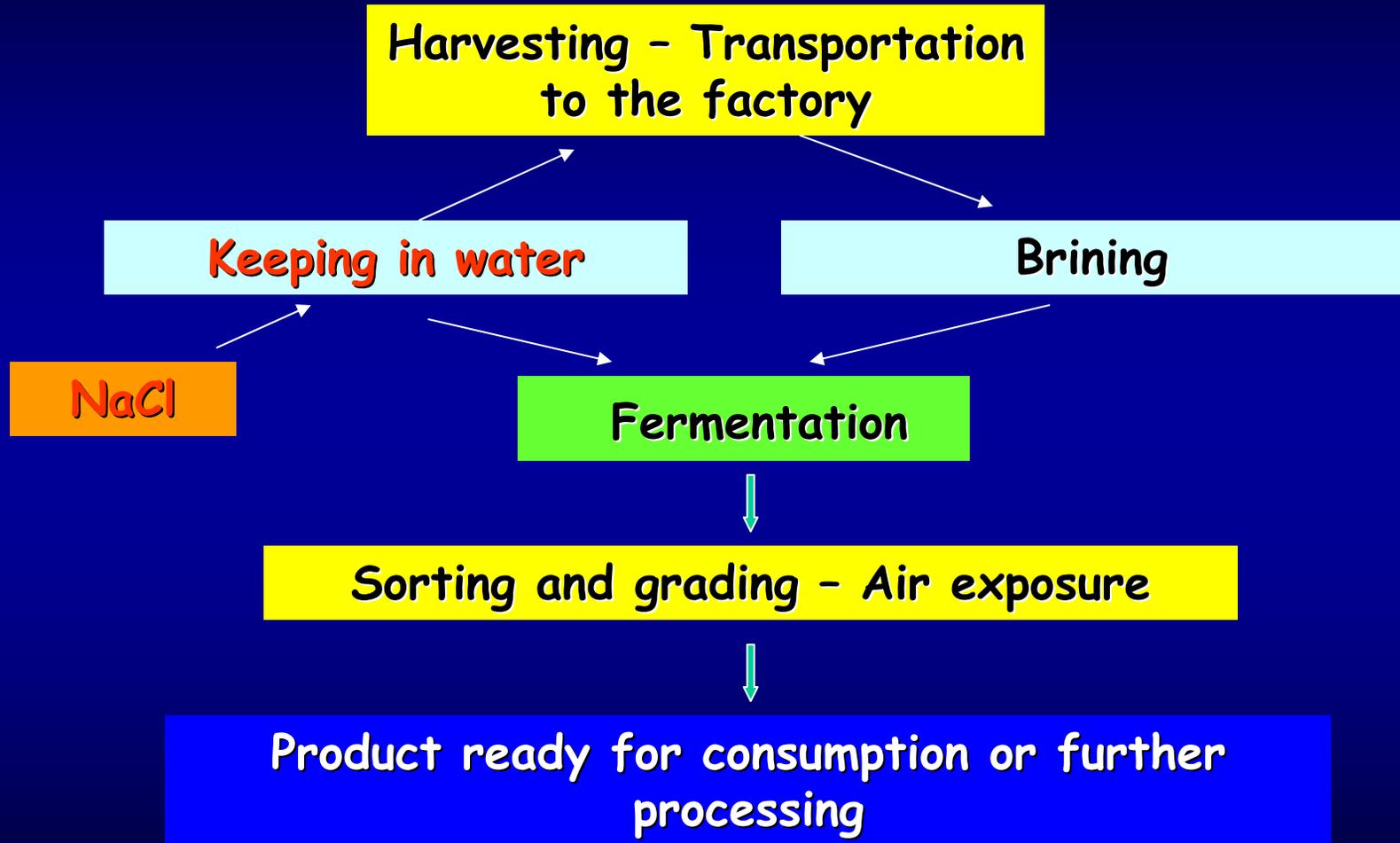
### Advantages:

- Natural processing with minimum input of chemicals
- Simple processing (traditional anaerobic method)
- Low energy consumption

### Disadvantages:

- Time consuming process (3-6 months)
- Possible damage to the crop before harvest due to early frosts

# Untreated black olives in brine (processing layout)



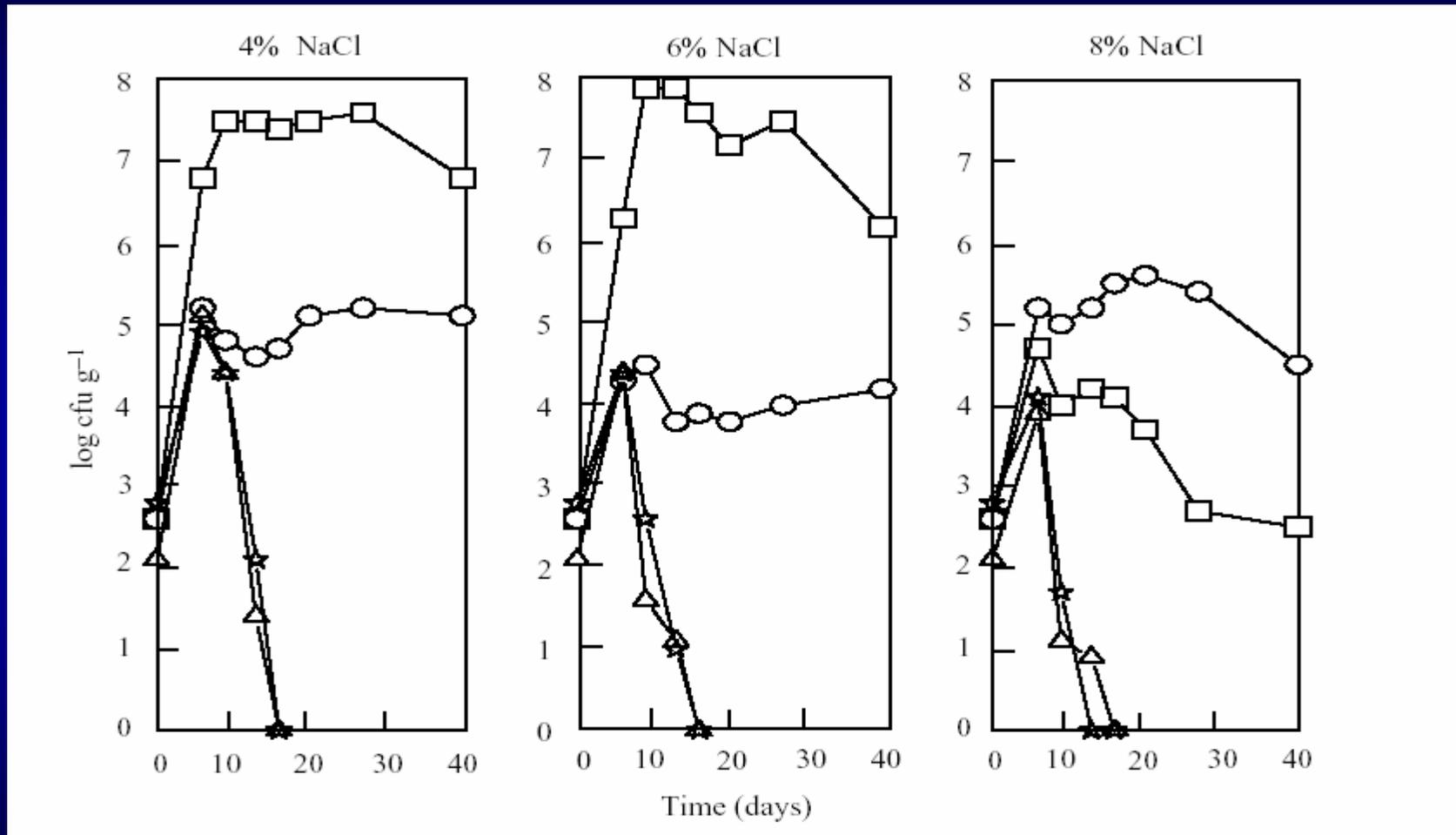
# Processing – traditional anaerobic method

- Olives are placed directly in brine, 8-10% NaCl
- Under these conditions, fermentation is carried out primarily by yeasts, non-sporulated gram-negative bacteria and sometimes lactic acid bacteria
- Fermentation is both alcoholic and lactic (to a lesser extend)
- The final product has pH 4,5-5,5 and titratable acidity 0,3-0,5% (expressed as lactic acid)

# Processing - new approach

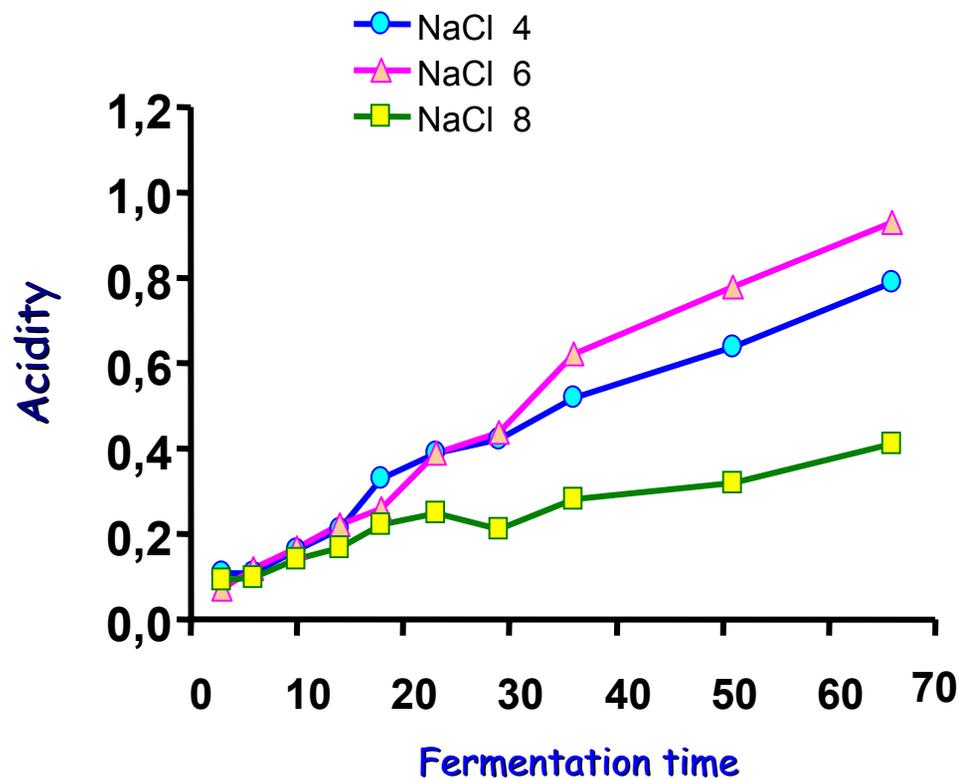
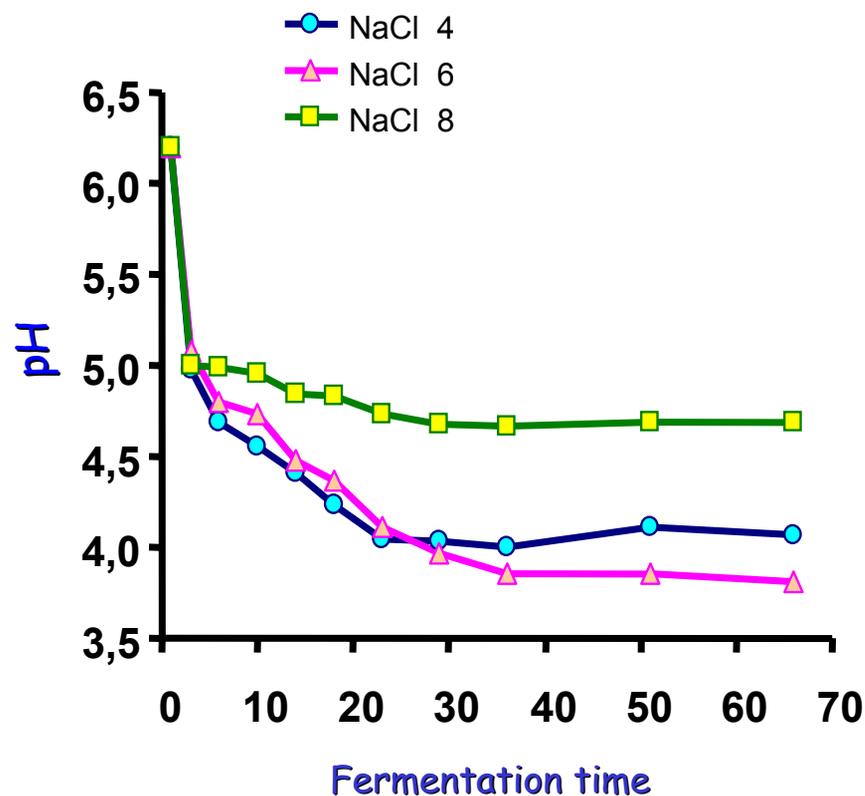
- Olives are placed directly in brine at 6-7% NaCl, which is kept constant throughout fermentation
- These conditions favour the growth of lactic acid bacteria which become the dominant microbiota. Yeasts co-exist with lactic acid bacteria at lower population densities
- Fermentation is primarily lactic and alcoholic (to a lesser extent)
- The final product has pH 3,8-4,0 and titratable acidity 0,8-1,0% (expressed as lactic acid)
- After fermentation, NaCl is adjusted to 8% to avoid spoilage
- Brine acidification is usually carried out with lactic acid

# Effect of NaCl on population dynamics during fermentation at 25°C

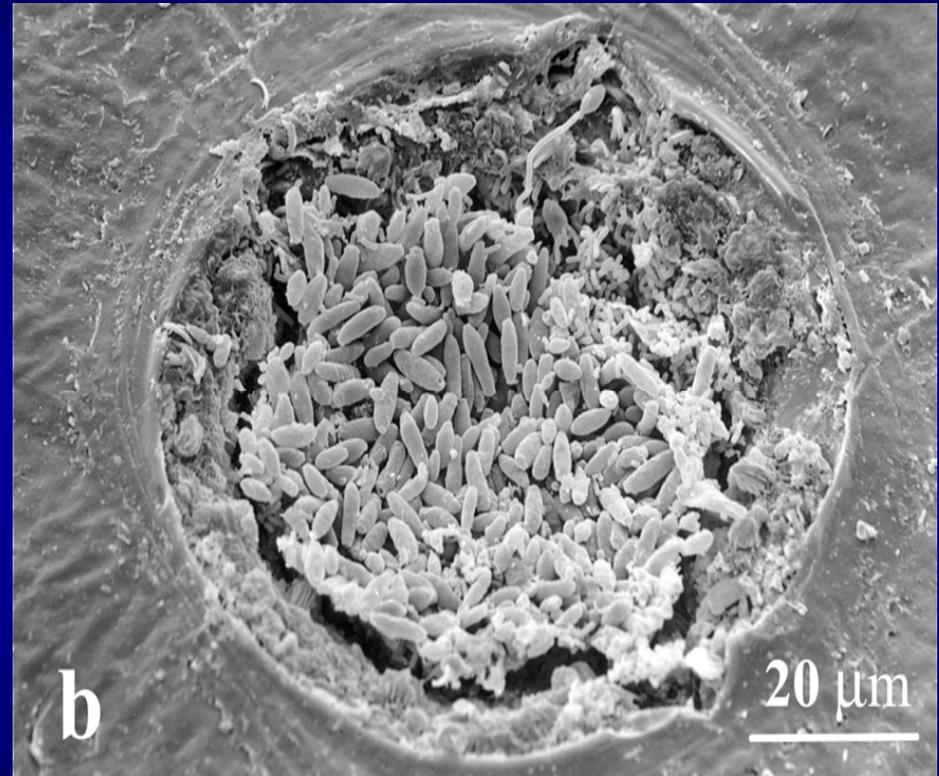
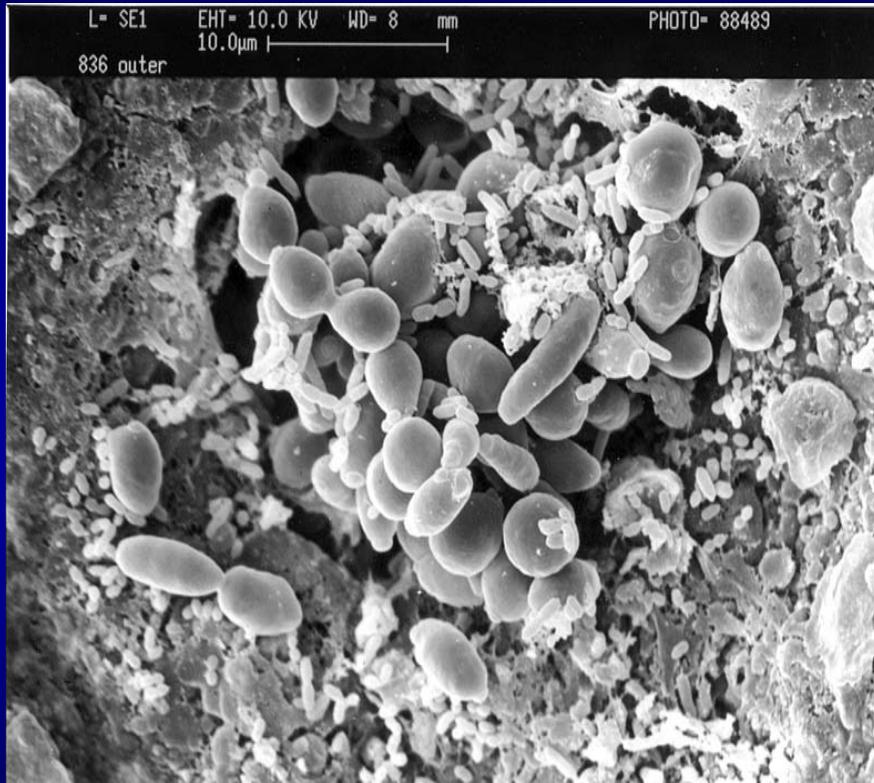


-□- lactic acid bacteria; -○- yeasts; -△- enterobacteria; -\*- pseudomonads

# Effect of NaCl level on pH and titratable acidity profile during fermentation at 25°C



# Spatial distribution of microorganisms during fermentation



# Dry salted olives

Harvest - Transportation to the factory



Sorting - Washing



Place in alternate layers with coarse salt (40%)

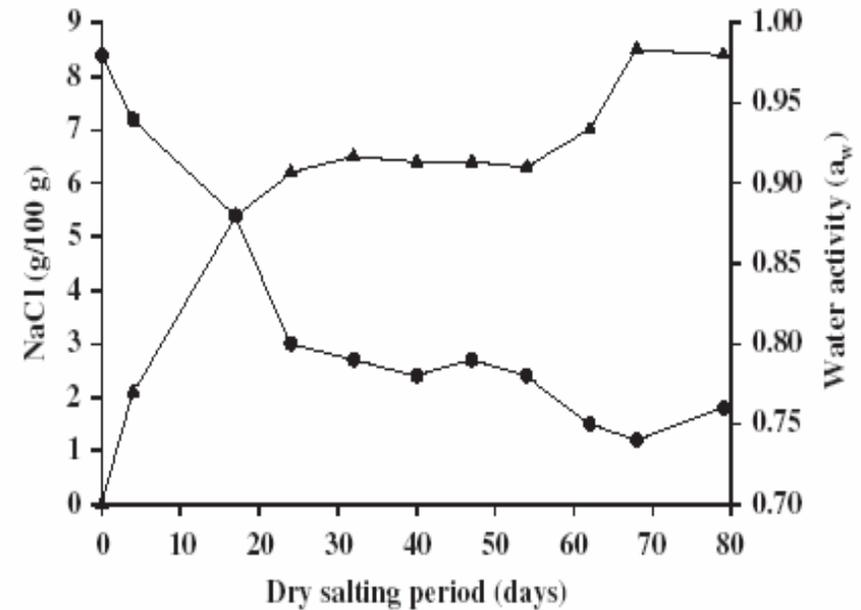
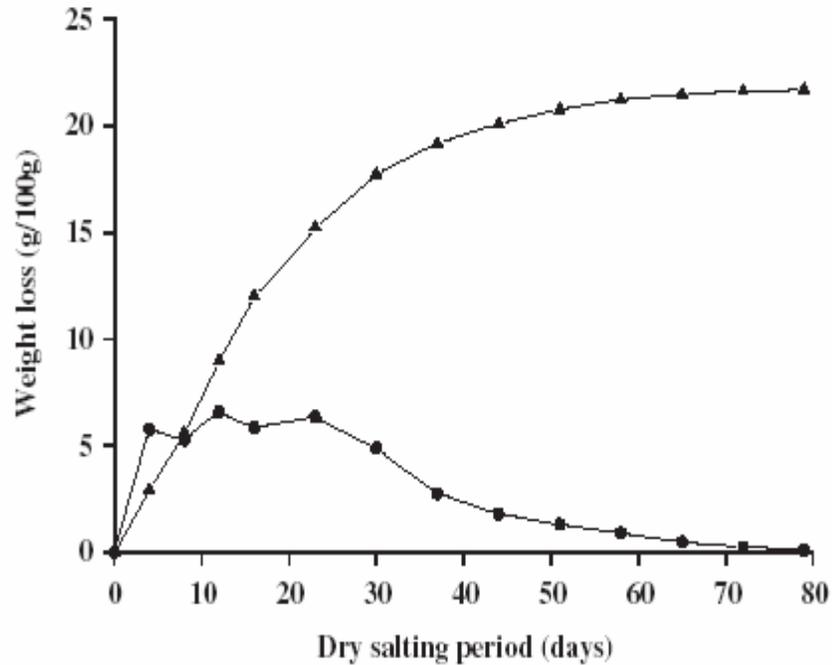


Solute loss - Shrivelling - Gradual debittering  
(curing)



Product ready for consumption (after 60-80 days)

# Dry salting process



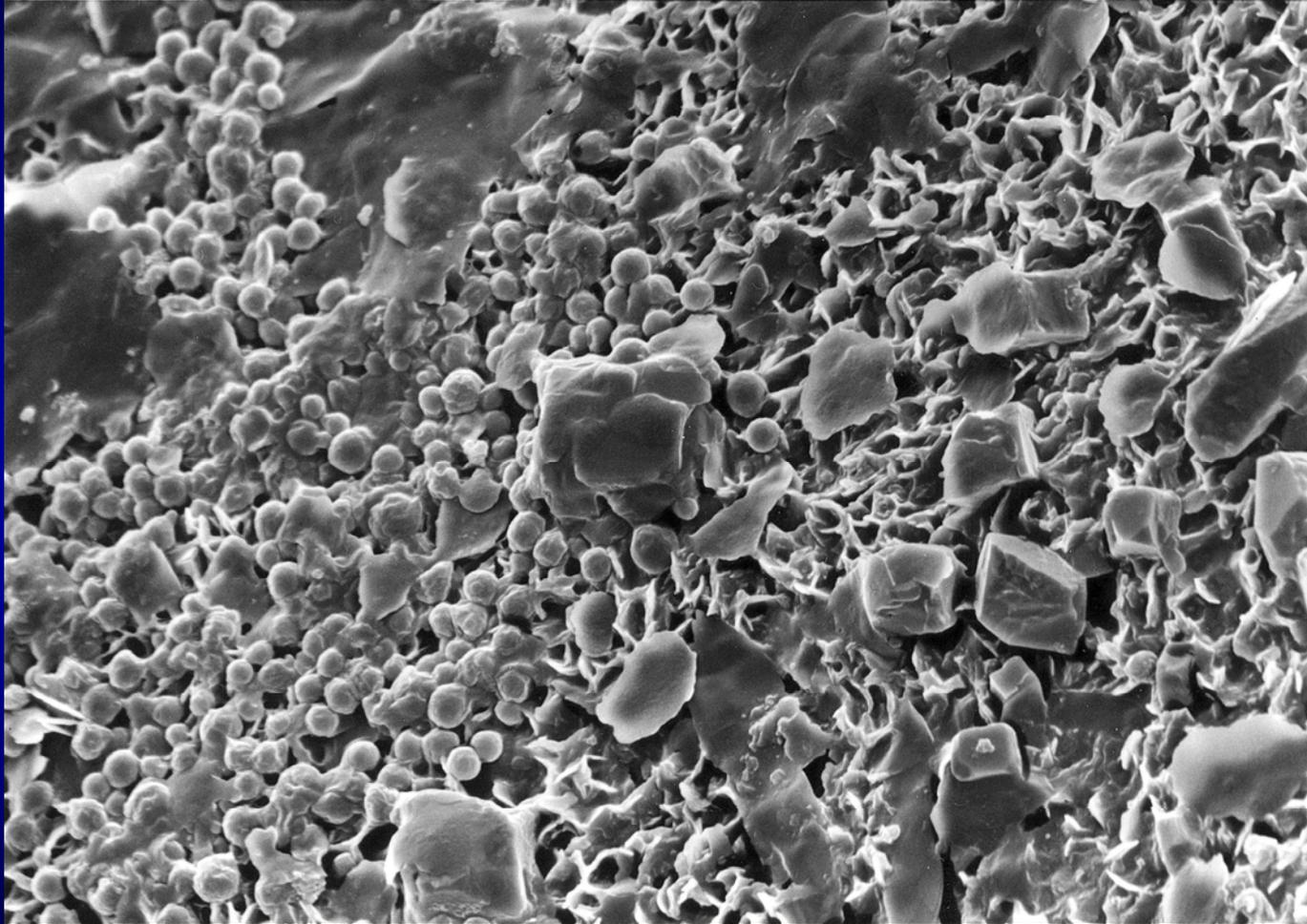
E. Z. Panagou (2006) *Greek dry-salted olives: Monitoring the dry-salting process and subsequent physicochemical and microbiological profile during storage at 4 and 20°C*, *Lebensmittel-Wissenschaft und-Technologie* 39:323-330.

# Dry salting process

Microorganism	Dry salting period (days)				
	0	20	40	60	80
Total viable counts	$6.5 \pm 0.7$	$5.9 \pm 0.4$	$4.7 \pm 0.6$	$5.6 \pm 0.5$	$6.0 \pm 0.4$
Lactic acid bacteria	$4.1 \pm 0.3$	<1	<1	<1	<1
Yeasts	$5.7 \pm 0.6$	$5.6 \pm 0.2$	$4.7 \pm 0.5$	$5.6 \pm 0.4$	$6.0 \pm 0.5$
Enterobacteria	$3.7 \pm 0.9$	<1	<1	<1	<1
Pseudomonads	$4.0 \pm 0.5$	<10	<10	<10	<10

- Initial microbiota consists of lactic acid bacteria, yeasts and gram negative bacteria
- Salt exerts a selective action resulting in the survival of salt tolerant yeasts

# Dry salting process

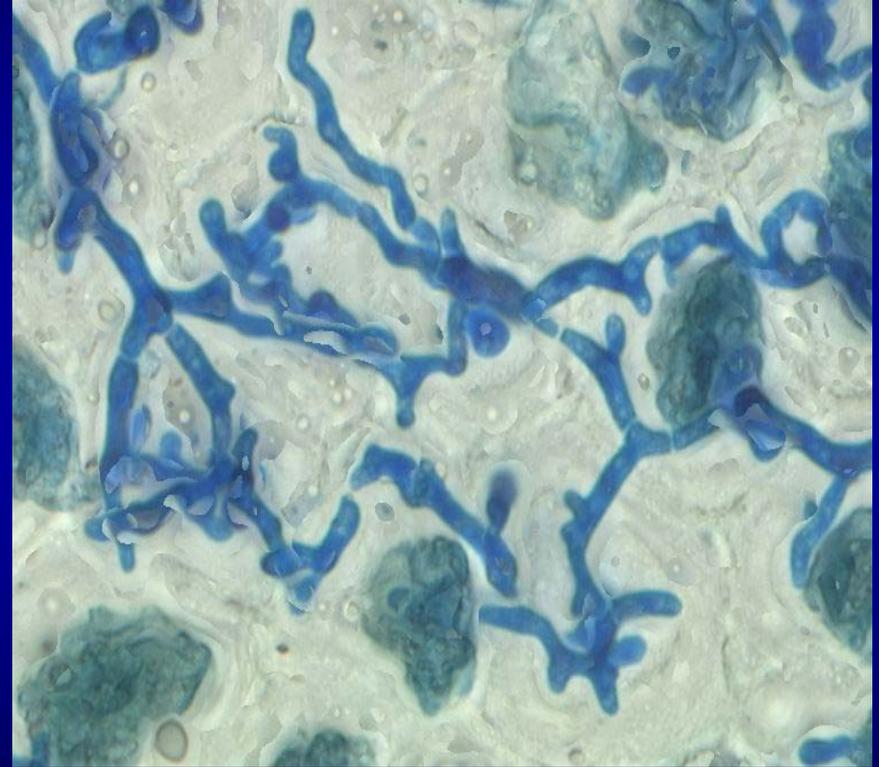
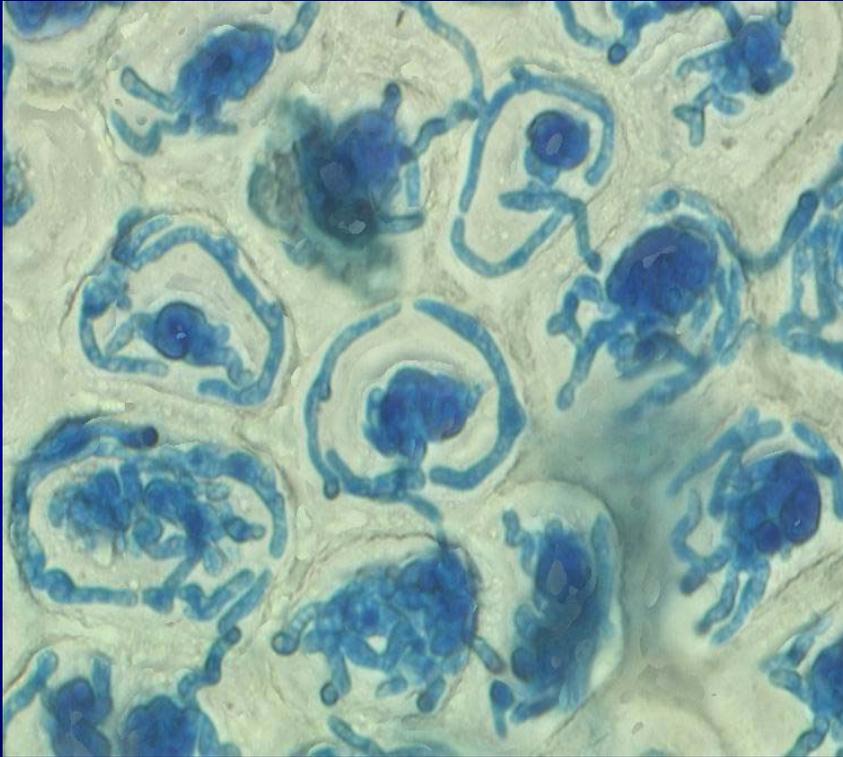


# Characteristics of the final product

- pH: 4.9-5.2
- Sodium chloride content in the flesh: 8.5-10.0 %
- Water activity: 0.75-0.85 (depending on the duration of the process)
- Reducing sugars: ~ 2%
- Dominant microbiota: salt tolerant yeasts (*Candida famata*)

Olives are marketed without brine (in dry) and are thus susceptible to fungal spoilage. There is external (visible) and internal (invisible) growth of mycellium.

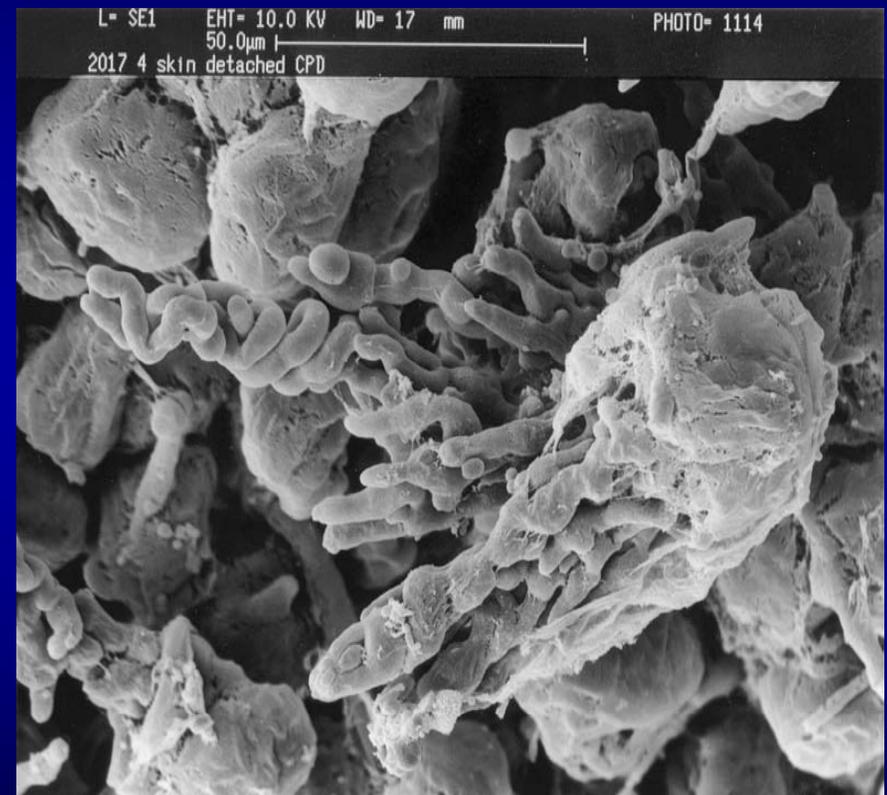
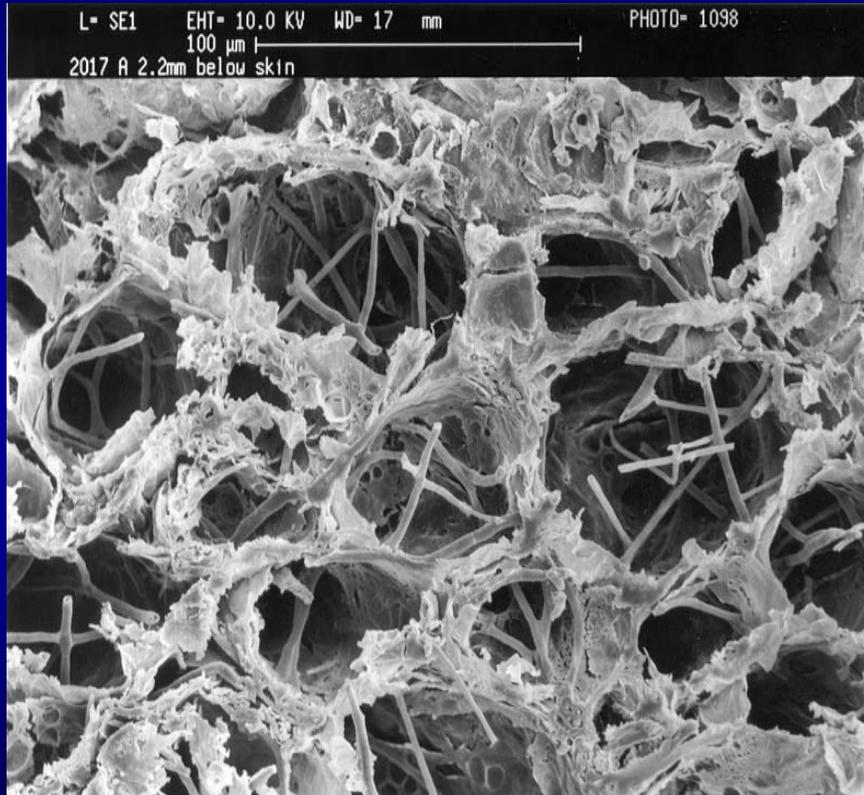
# Growth of internal mycelium



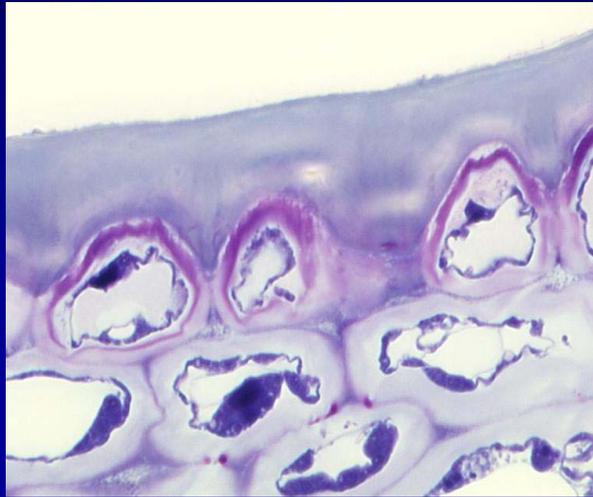
# Growth of internal mycelium under SEM



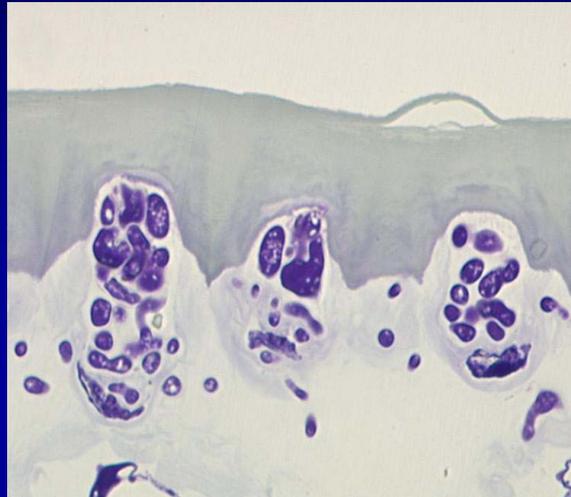
# Growth of internal mycelium under SEM



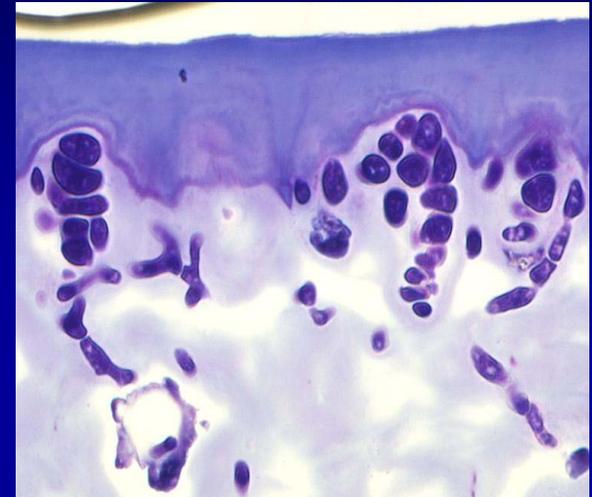
# Treatments to minimise the extend of fungal growth



100% CO<sub>2</sub>



100% N<sub>2</sub>



Dip in 1% (w/v) potassium sorbate for 10 min

# Concluding remarks

Although table olive fermentation is still empirical in Greece, the existing quality of Greek-style table olives is generally good. However, additional steps must be taken for product improvement in the following directions:

## In the area of processing:

- Implementation of quality control systems (HACCP, ISO) by all processing units
- Employment of specialised scientific and technical personnel
- Training of personnel to the latest trends in olive processing
- Encourage farmers to avoid fermentation in their own installations

## In the area of marketing:

- Improve hygienic conditions for product marketed in bulk
- Promotion of standardised/packaged olives instead of selling in bulk
- Adequate quality control of the product in the market by food inspection authorities



Thank you very much for  
your attention

