

# *Uses of Clarified Lemon Juice as an Acidulant*



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# **Introduction**

Overview of citrus production  
and demand

## **New perspectives about consumption**

- Citric acid
- Clarified lemon juice

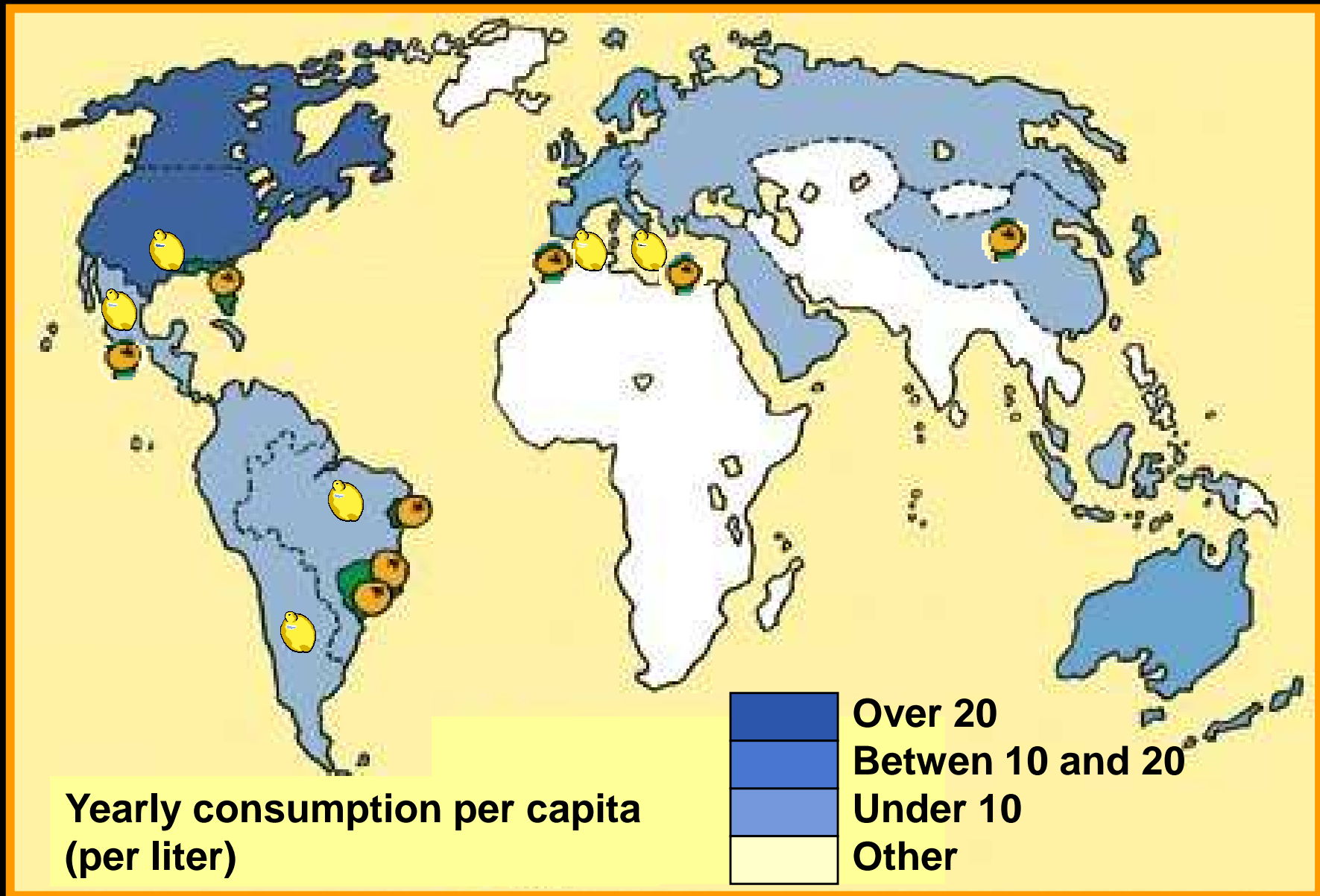
## **Utilization of by-products**

Citrus Research  
Center at Spain

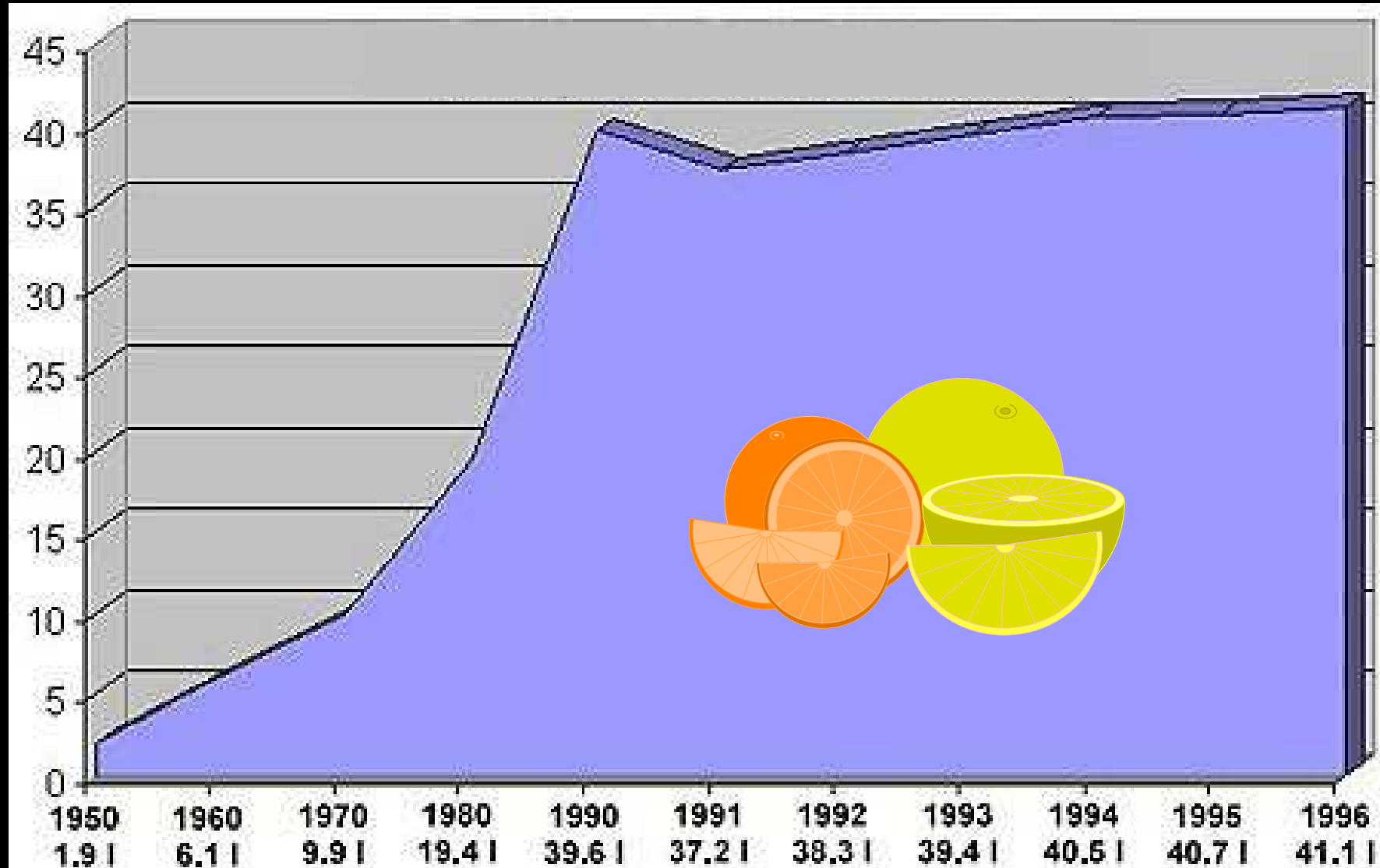


# *Citrus Consumption Overview*

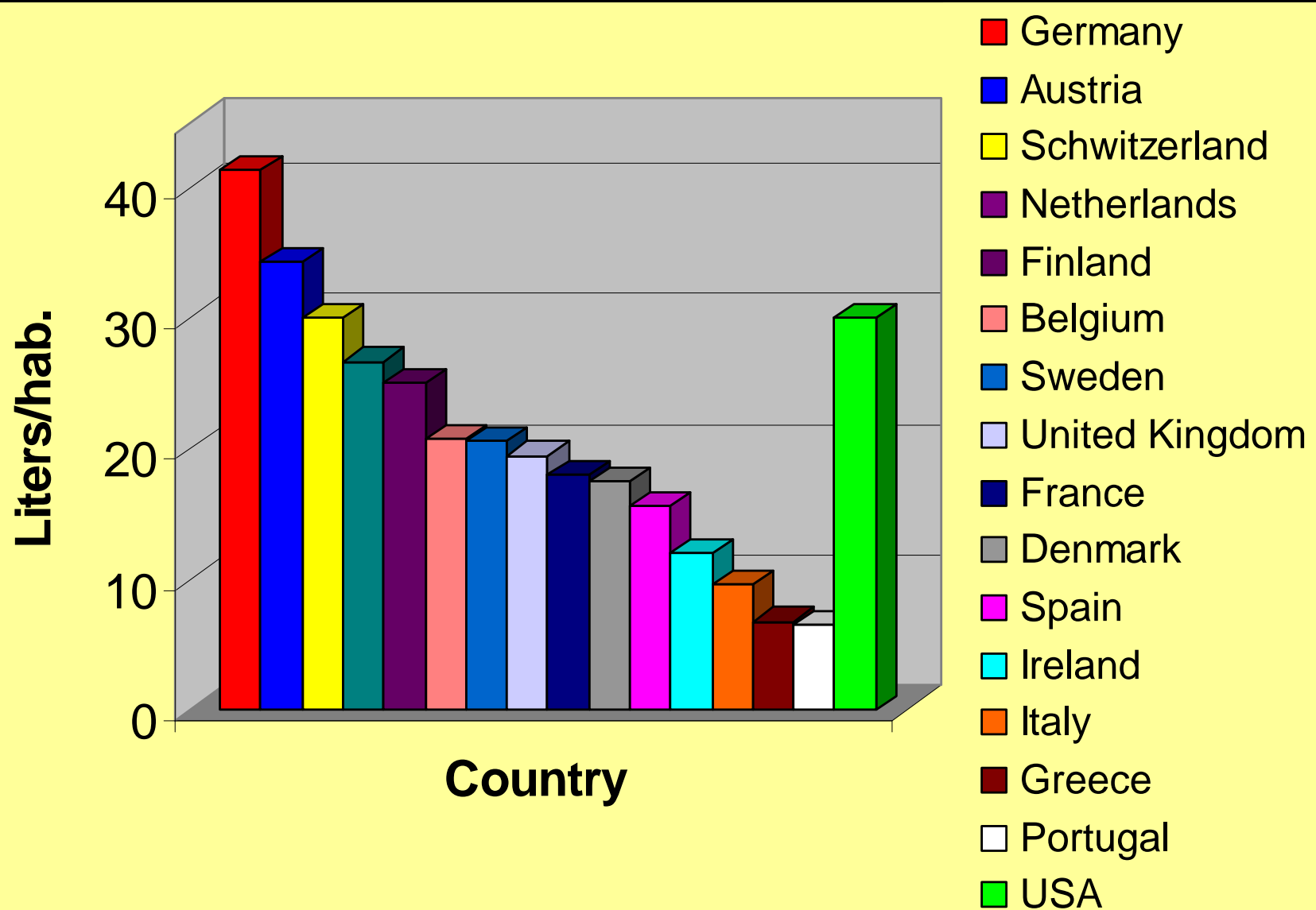
# *World-wide Citrus Market*



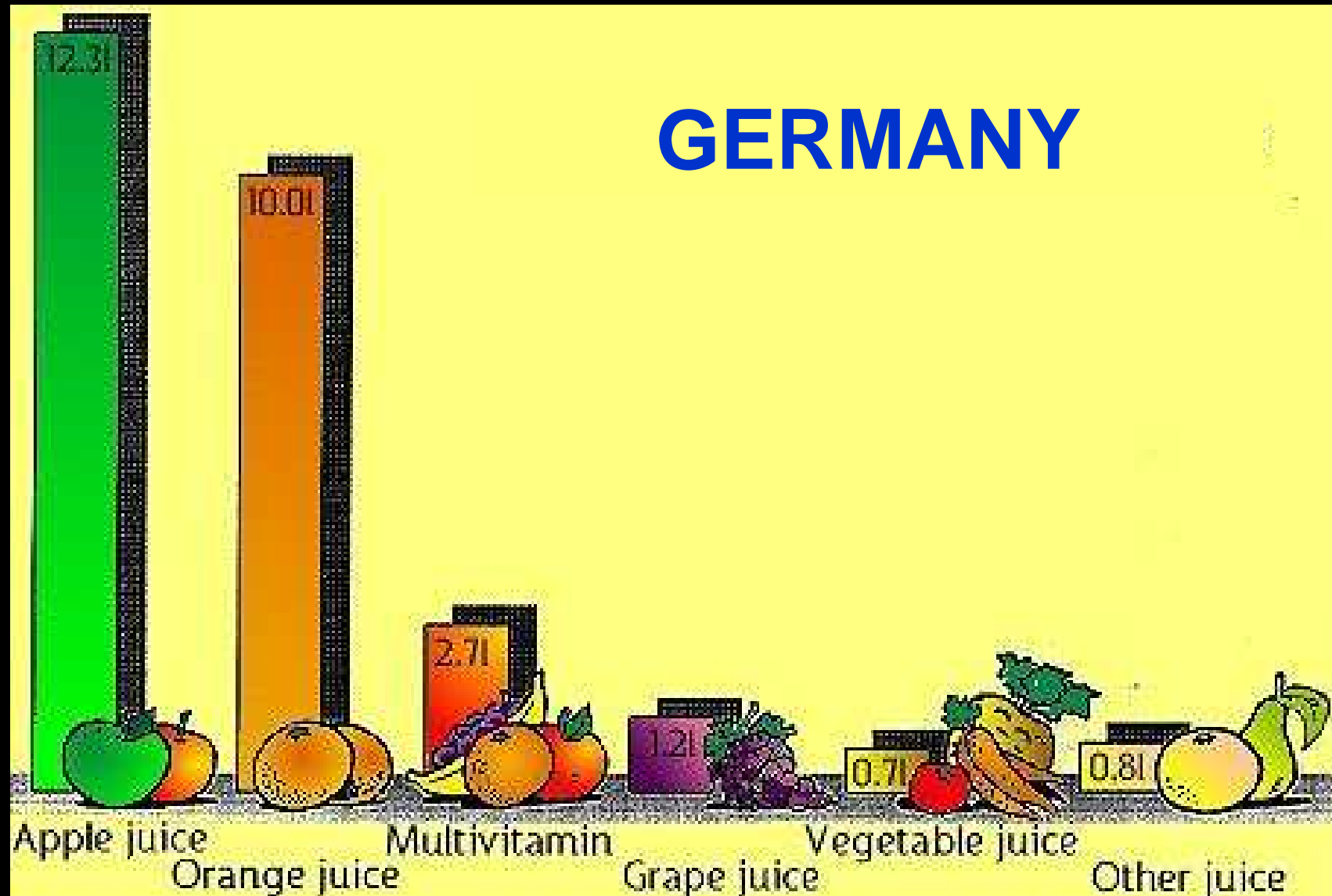
# *German Consumption of Fruit Juices*



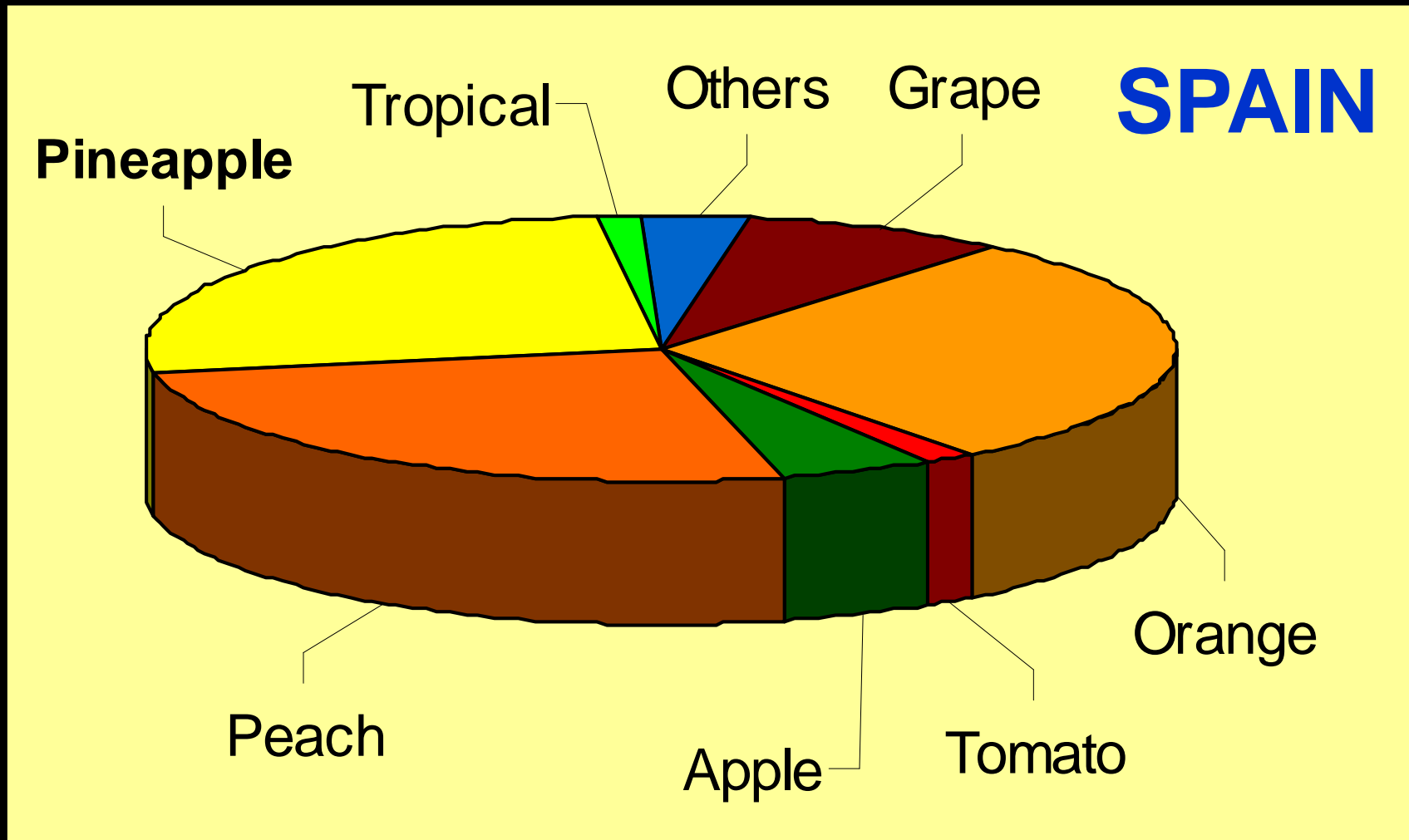
# *Consumption of Fruit Juice in Europe*



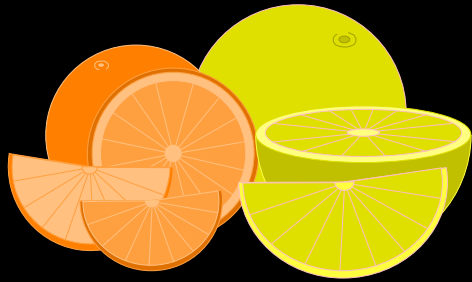
# *Trends in Fruit Juice Consumption*



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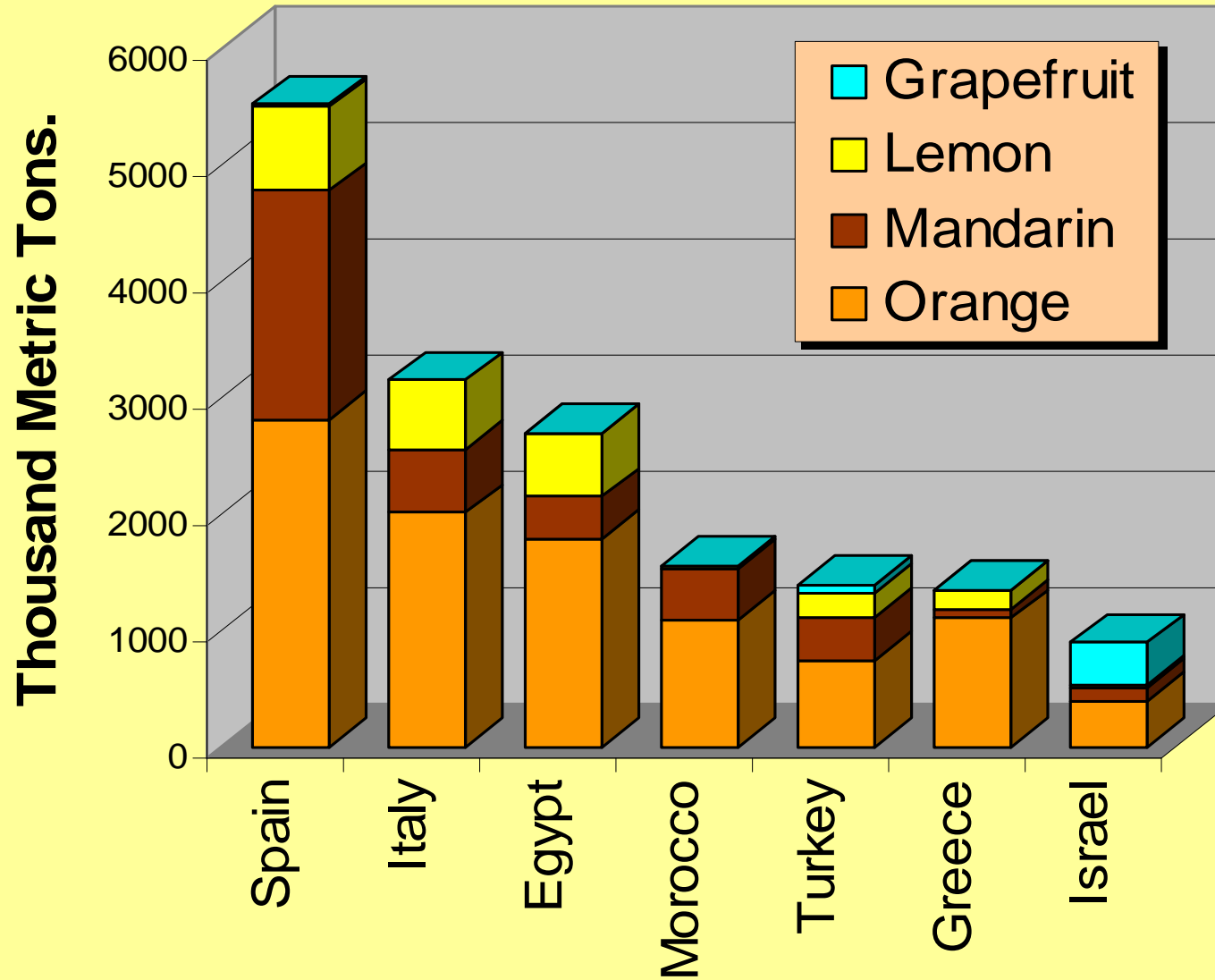


*European  
Citrus Production*

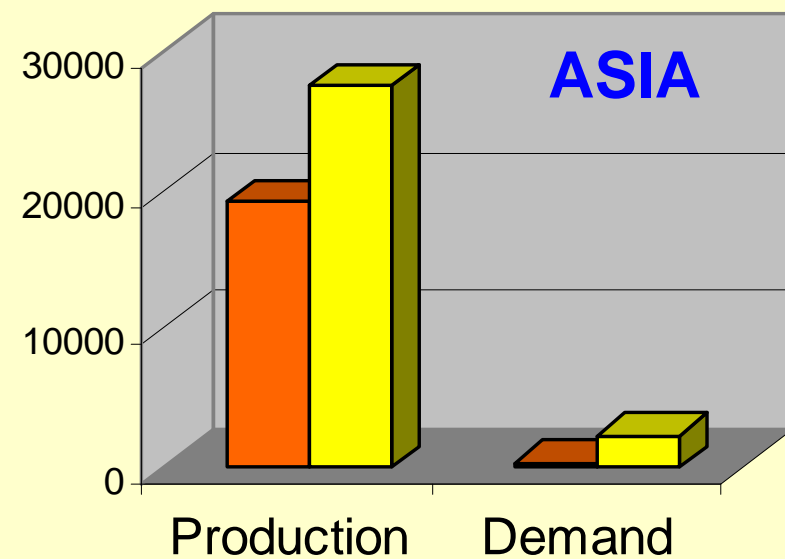
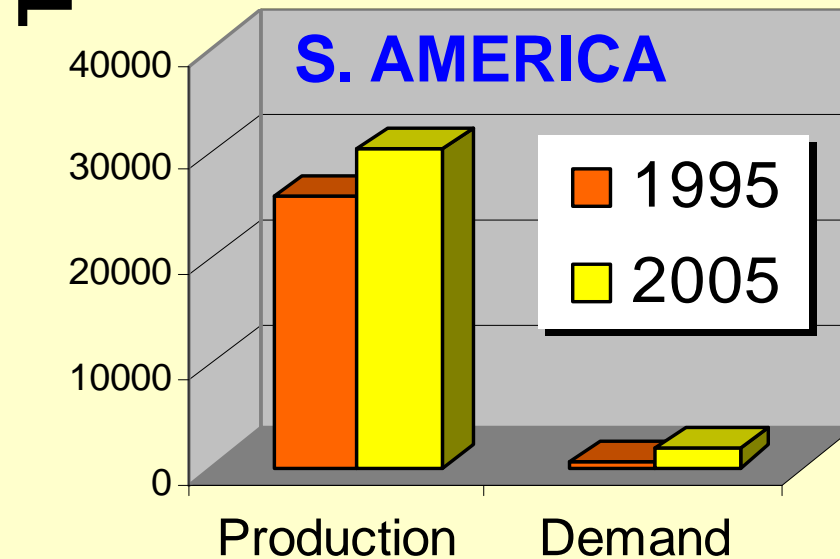
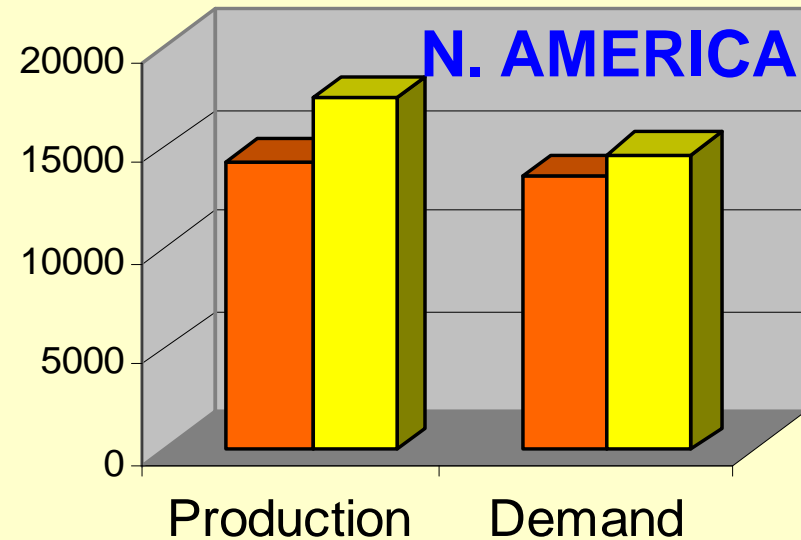
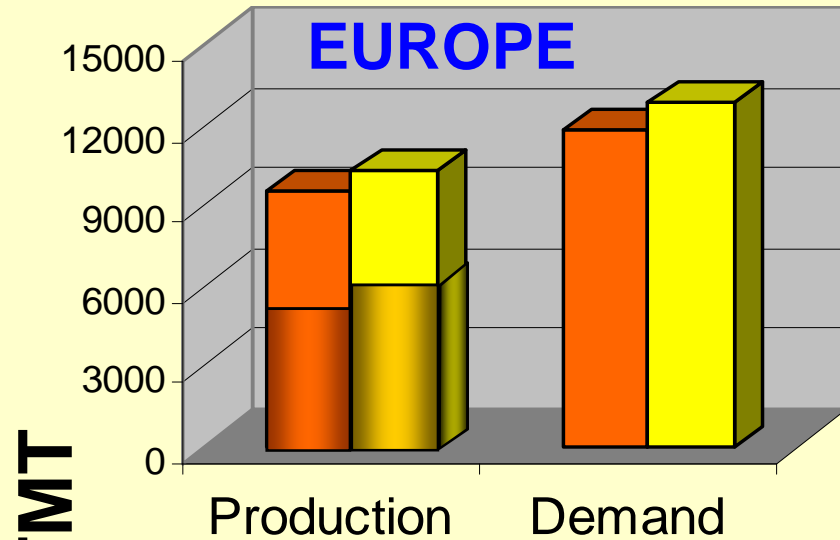
# *Citrus Market in Europe*

- **Spain:**
  - 4th** World producer.
  - 1st** producer in Europe and Mediterranean area. Southeastern coast.
- Orange, mandarin and lemon.
- Reconstituted from concentrate (FC), not from concentrate (NFC).
- Chilled juice consumption has doubled since 1990 (10%).

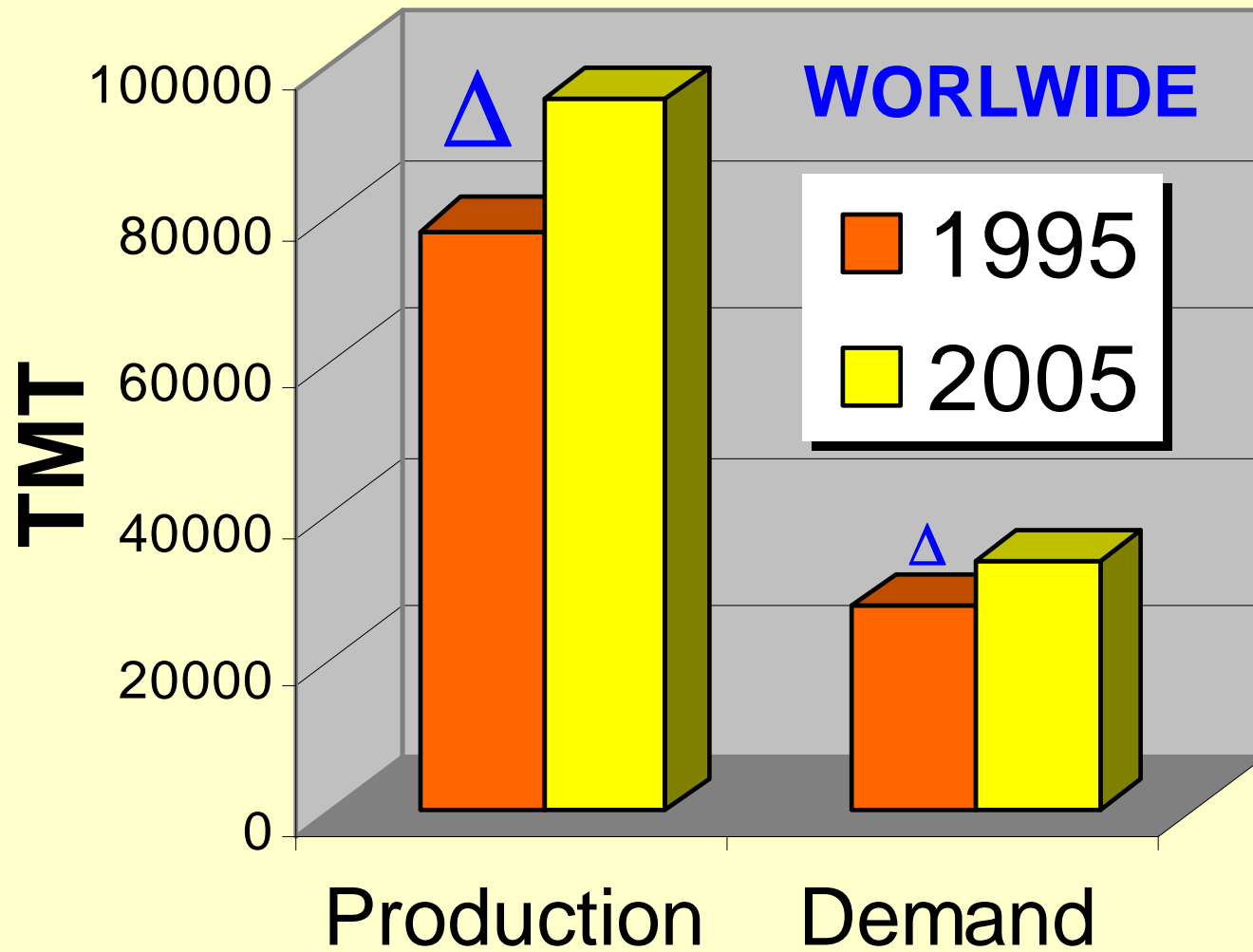
# *Citrus Production in the Mediterranean Area*

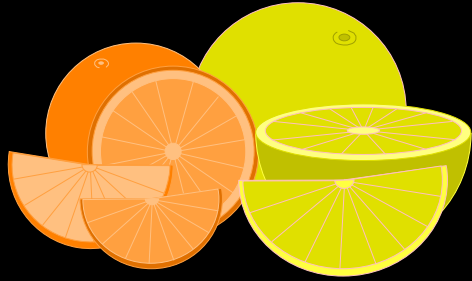


# Citrus Production versus Demand



# *Citrus Production versus Demand*



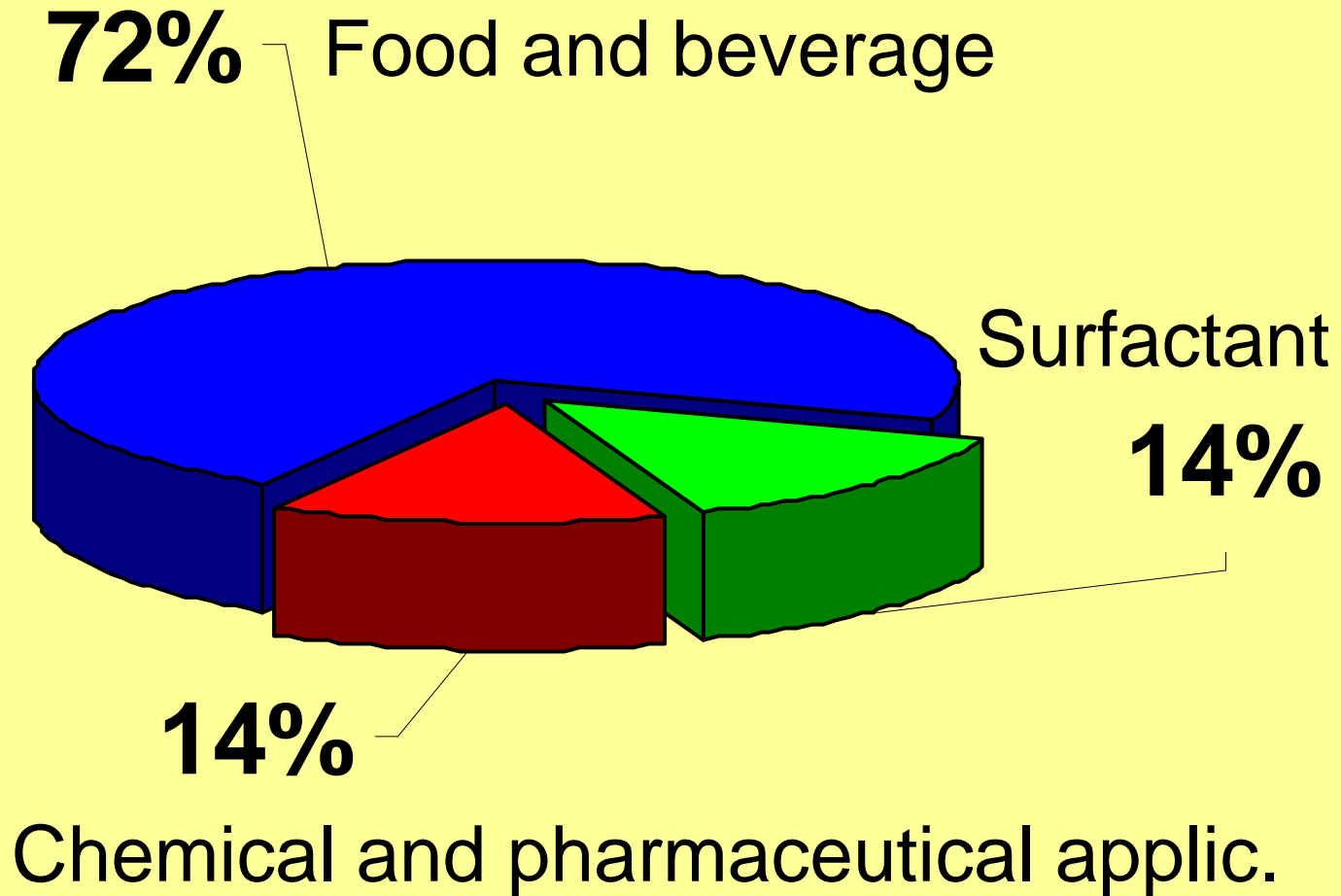


*Citric Acid*  
*as an Acidulant*

## *Citric Acid as an Acidulant for Food and Beverages*

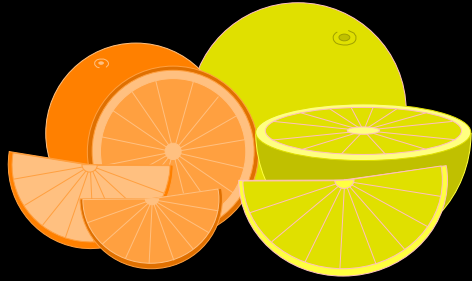
- **Europe** is the main producer (45%)
- **United States** is a net importer
  - ⇒ Household detergents and cleaners.
  - ⇒ Food and beverages.
- **Growth** rate of 4 - 7% per year.

# *Demand for Citric acid*



↑Citrus-based / ↓phosphoric-based



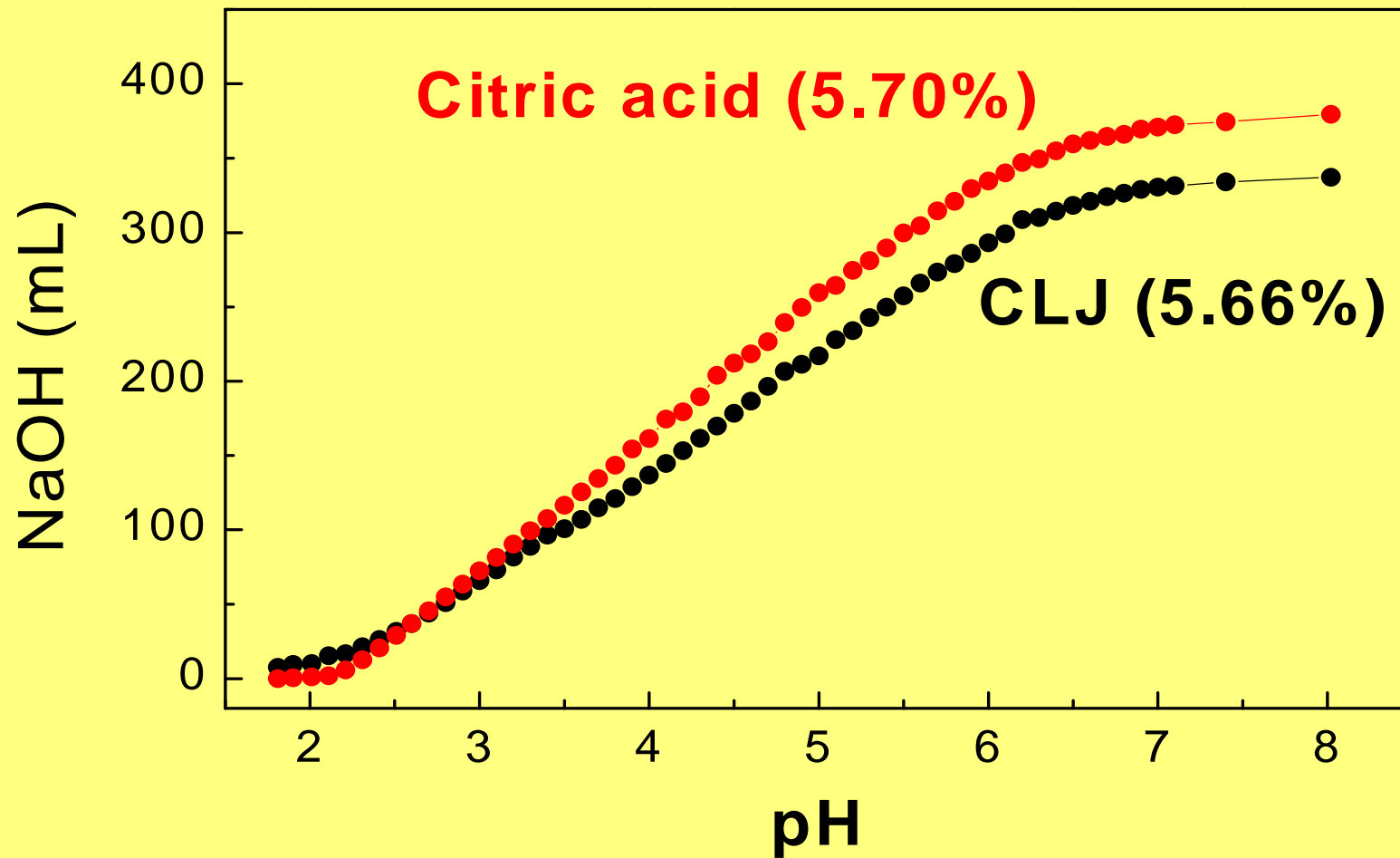


*Clarified Lemon Juice  
as a Natural Acidulant*

# *Acid Components in Lemon Fruits*

- **Organic acids** (citric, malic, fumaric and oxalic).
- **Citric / malic** : 14-30 (maturity)
- **High titrable acidity**  $\Rightarrow$  High quality
- **5-6 g acid /100 ml turbid juice.**
- Titrable acidity does not change with **cross-flow filtration.**

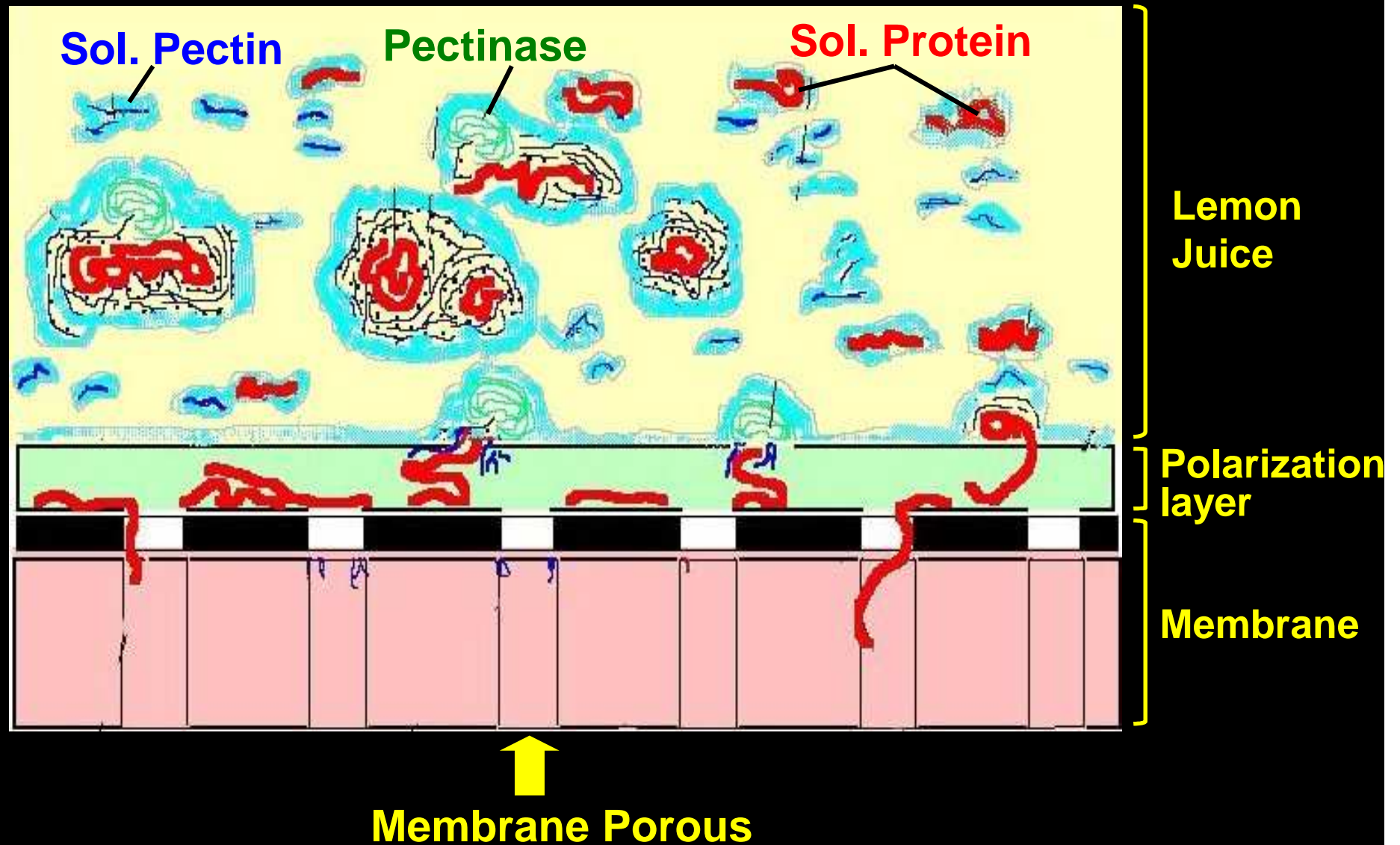
# *Total acidity of commercial citric ac. versus clarified lemon juice*

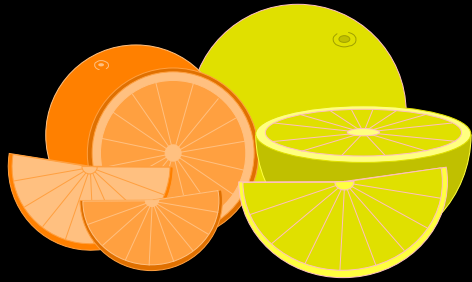


# *Turbid and Clarified Lemon Juices*

	<u>Turbid</u>	<u>Clarified</u>
Pectin as MGA. (ppm).....	351	240
pH.....	2.4	2.3
°Brix.....	12.9	10.8
Citric / malic.....	9.2	7.7
Total acidity (g/L as citric. ac.)..	5.1	4.8
Vitamin C (mg/100 ml).....	60.1	56.5
Sugars (g/100 ml).....	11.9	9.9
Nitrogenous subs. (g/100ml)....	0.53	0.32
Volatile comp. (ppm).....	960	20

# *Lemon juice cross-flow filtration*



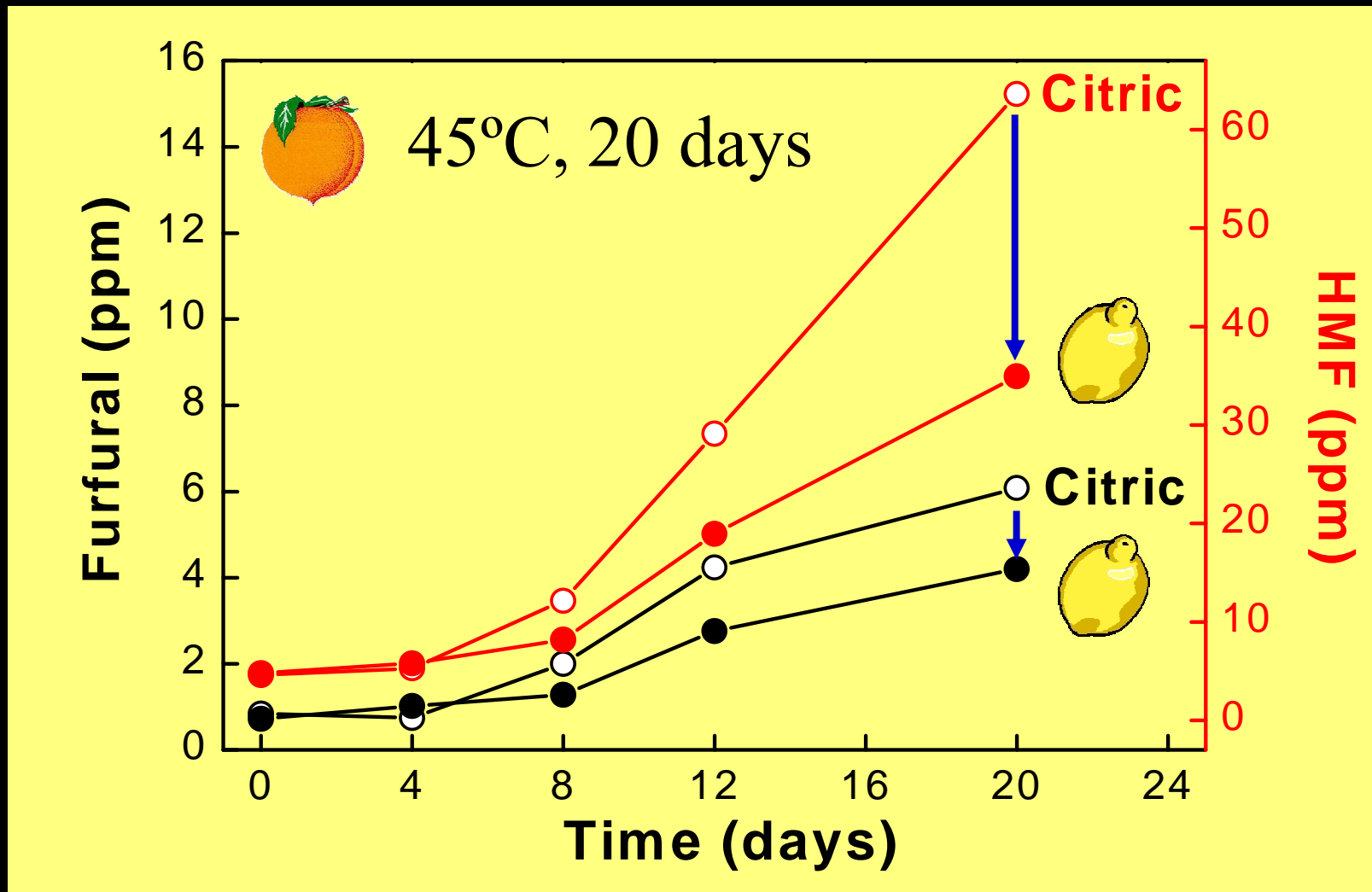


*Advantages of Lemon Juice  
as a Natural Acidulant  
versus Citric Acid*

## *Advantages of Lemon Juice as a Natural Acidulant versus Citric Acid*

1. **Less browning** reactions under storage.
2. Higher **nutritional value**.
3. **Better acidic taste** profile.
4. Improvement on the **color** and **flavor** profile.

# 1. Browning Reactions



↓ furfural and HMF in *Prunus* nectars



## *2. Nutritional Value*

- **Vitamin C** (Bioavailability)
- **Flavonoids** (Antioxidants)
  - eriodictyol, hesperidine, quercetin and phloroglucinol.
- **Protective Properties**
  - Degradation of sugars, aminoacids and vit C (Pasteurization)
  - Carotenoids, anthocyanins and xanthophylls (Color).

# *Designing of Nutraceutical Products*

- Relationship bet. nutrition and risk of disease.

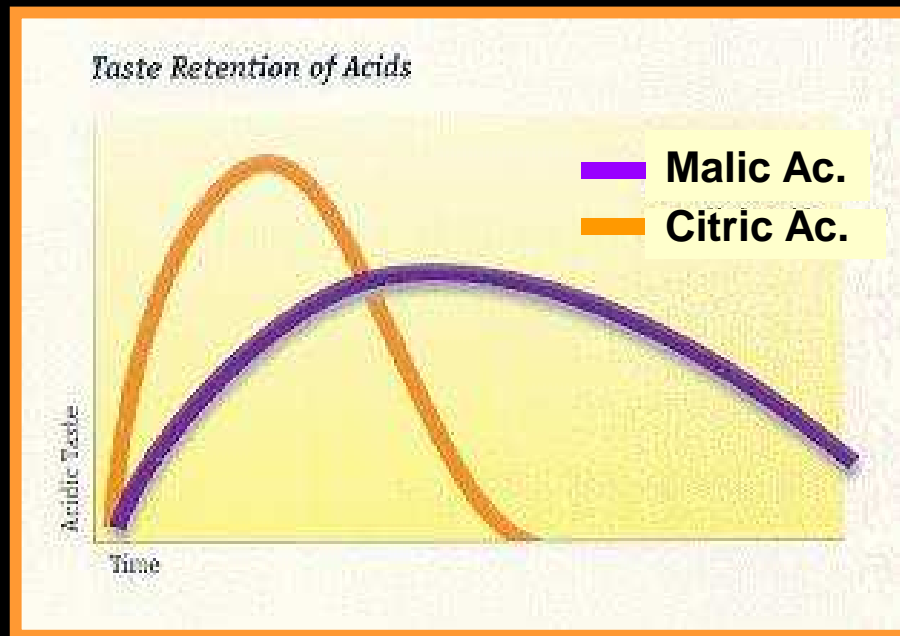
*“You are what you eat”*

- Some nutrients reduce cancer and heart disease.

<i>Compound</i>	<i>Action</i>	<i>Source (100 ml juice)</i>	<i>Daily value</i>
<b>Vitamin C</b>	Antioxidant	60 mg	60 mg
<b>Flavonoids</b>	Antioxidants	3 mg	--
<b>Vit A</b>	Visual perception	20 IU	10 IU
<b>Vit B<sub>1</sub>, Thiamine</b>	Nerve transmission	0.1 mg	1 mg
<b>Potassium</b>	Nerve transmission and cell strength	140 mg	3,500 mg

### 3. Acidic Taste Profile

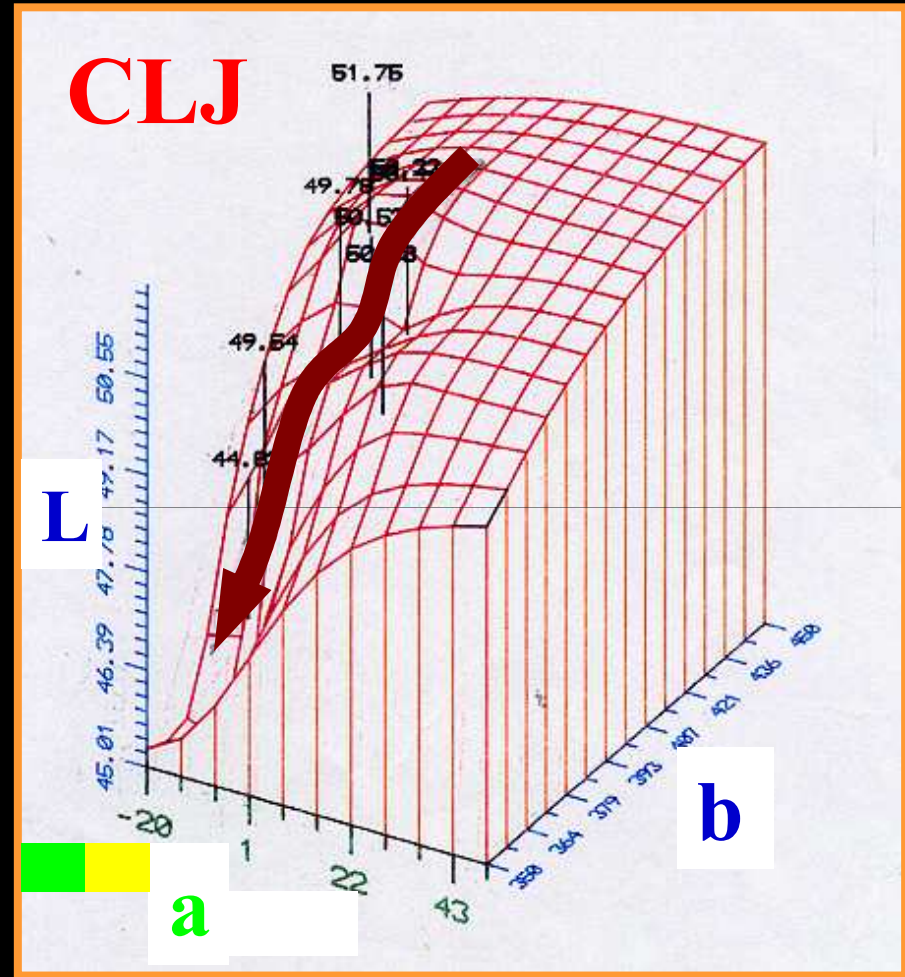
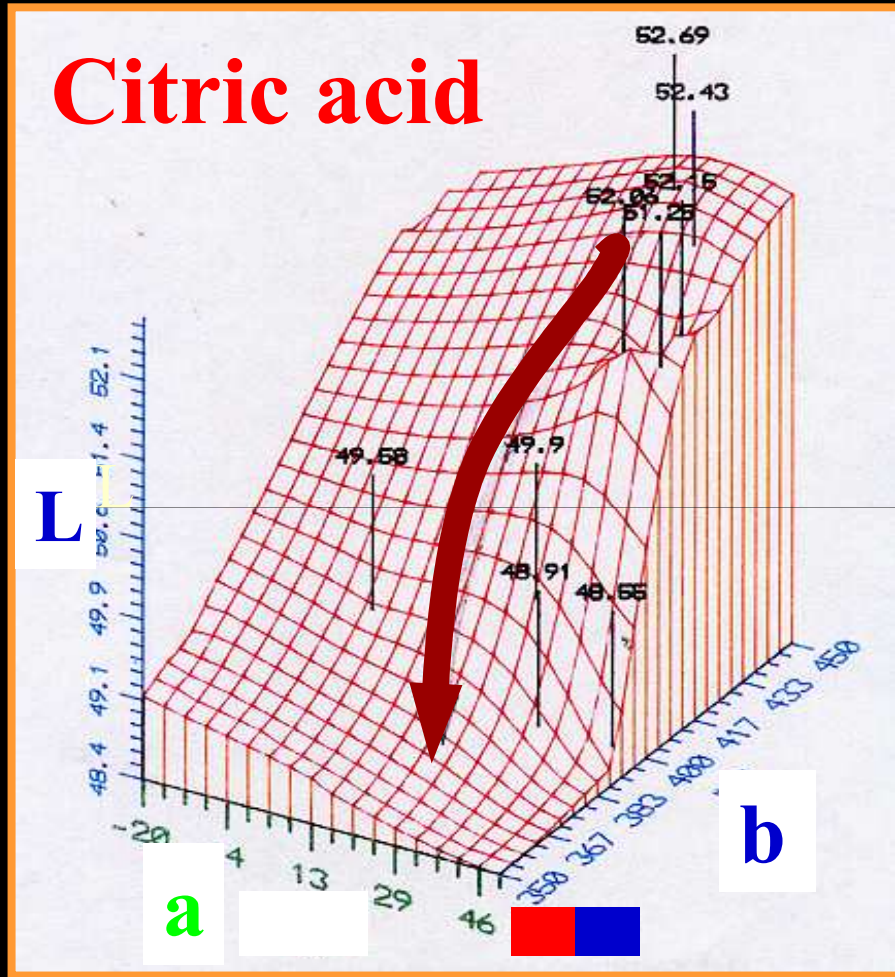
- Citric and **malic** acids.
- Malic acid (apple):
  - Taste-blending qualities (fruit flavour).



- Synergy with high intensity sweeteners.
- Prolonged acid taste.

**Acidulant for beverages**

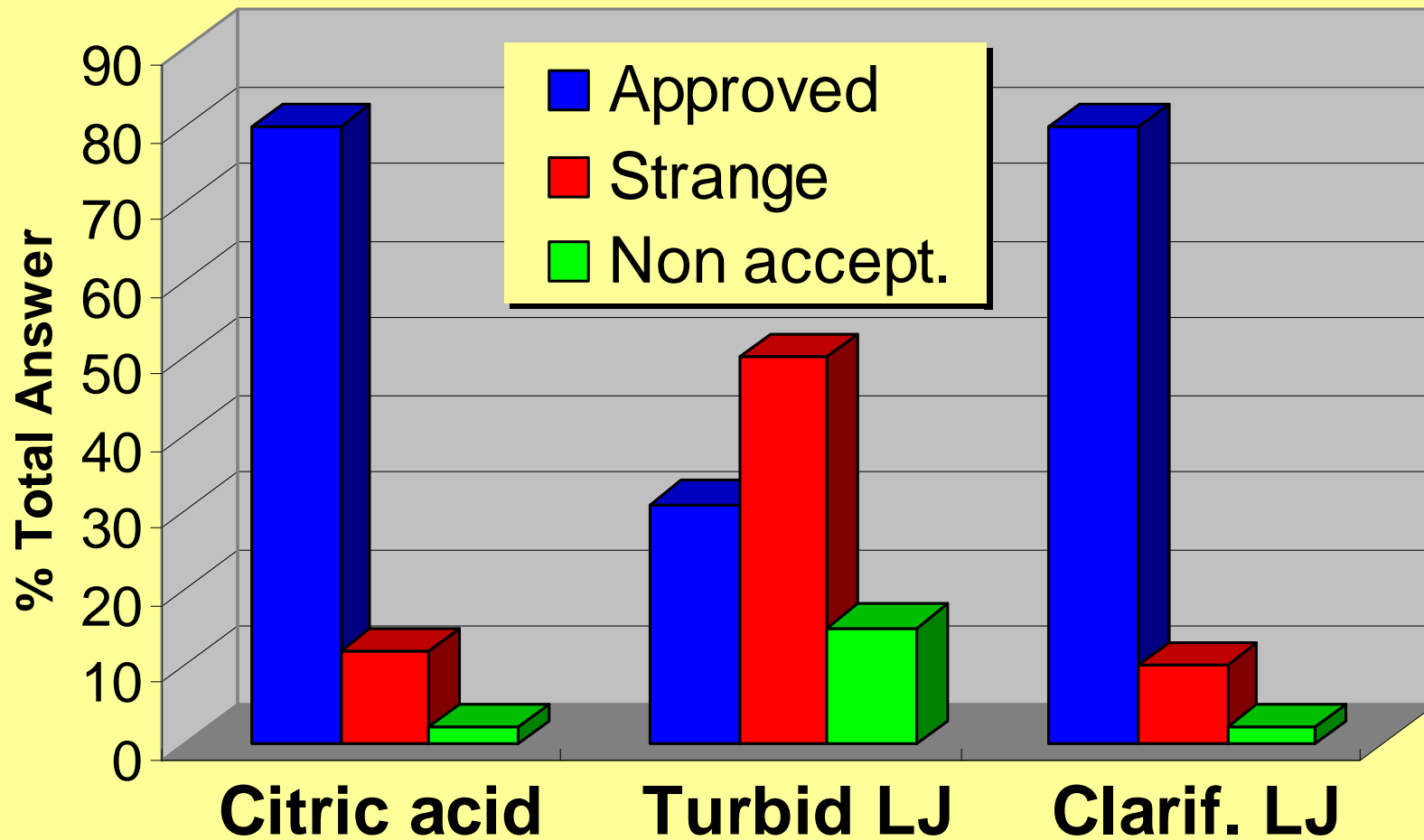
# 4A. Color Profile



CLJ  $\Rightarrow$  Lower browning under storage at 30°C

## 4B. Flavor Profile

### Aroma



# *Manufacturing Costs*

- Use of lemon juice as an acidulant in canned peach in syrup  $\Rightarrow$  **small increase of the manufacturing direct cost of 0.2%** (referred to the sale price)
- A low increase in the sale price by offering these products as **natural and healthier canned fruit.**
- Many other **applications** in food and beverages.