



ESCOLA SUPERIOR DE BIOTECNOLOGIA  
UNIVERSIDADE CATÓLICA PORTUGUESA

# NEW PRE-PROCESSING TECHNOLOGIES FOR FRUITS AND VEGETABLES

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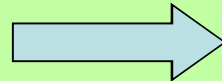


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A short trip on current processing technologies . . .



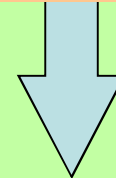
**Fruits and vegetables**



highly perishable



**PRESERVATION  
METHODS**



Availability throughout  
the year



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A short trip on current processing technologies . . .

### Vegetable processing operations



Harvesting → reception of raw product and primary grading / screening





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A short trip on current processing technologies . . .

### Vegetable processing operations



Soaking and washing → Sorting and grading → **Product preparation**



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### Vegetable processing operations

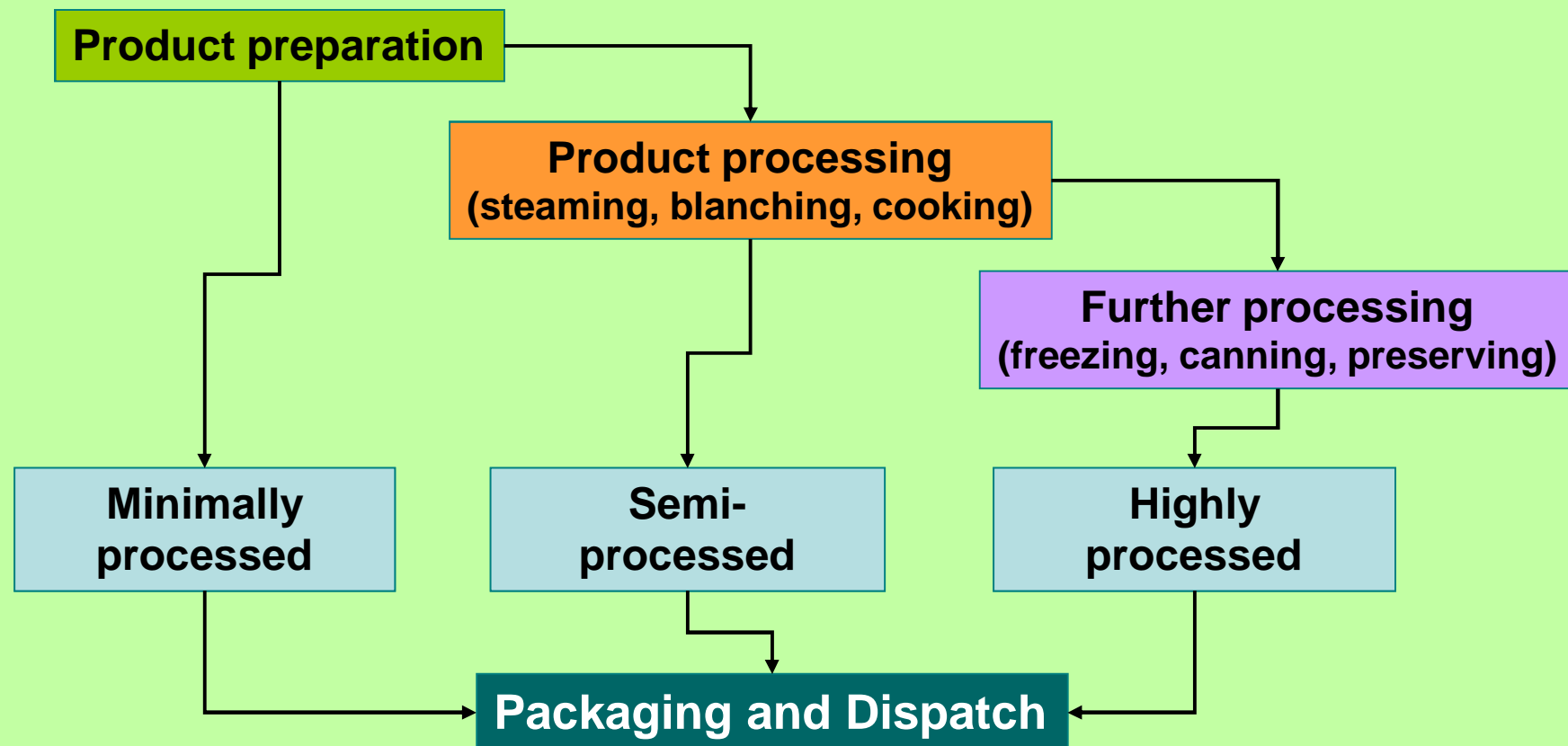


Product processing: steaming / blanching / cooking



## A short trip on current processing technologies . . .

### Vegetable processing operations



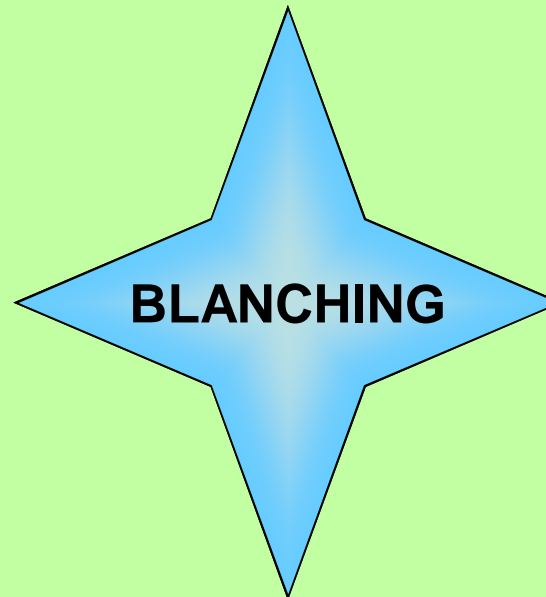


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## Blanching

**Thermal treatment**

**Inhibition of natural  
enzymes  
responsible for  
quality deterioration**



**Elimination of  
foodborne pathogens**

**Inhibition of spoilage  
microorganisms**





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## Enzymes

**Affect QUALITY**

**Off-colors**

**Off-flavours**

**Off-odors**

Thermal inactivation of some sorts of enzymes may increase the products shelf life, and is frequently used as an index for the thermal process adequacy.

**MARKERS: Peroxidase, Catalase**





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### Blanching

**Essential before  
vegetables freezing**

**freezing only slows enzyme activity;  
it does not destroy or completely stop it.**

**Blanching time  
*depends on***

**size, shape, thermal conductivity and  
natural levels of enzymes.**



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The problem is... Heating!

**WANTED !!!  
NEW TECHNOLOGIES**

Reducing the number of routes  
Reducing the quantity of some nutrients



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## New Processing Technologies

### **NON THERMAL TECHNOLOGIES**



**little loss of:**

- **colour**
- **flavour**
- **texture**
- **nutrients**

**...but still retaining the desired shelf-life and safety!**



## New Processing Technologies

### **Pulsed Electric Fields**

**Exposure of food to an intense electric field by means of controlled pulses of high voltage**

### **Ohmic Heating**

**Generation of heat inside the food as a consequence of Joule effect**

### **Radio Frequency**

**Exposure of food to electromagnetic waves in the radio-frequency range**

### **Microwave**

**Exposure of food to controlled microwaves**

### **High Pressure**

**Short-time exposure to extremely high pressure (up to 5000 bar)**





## New Processing Technologies

**Super Critical CO<sub>2</sub>**

**Contact of food with CO<sub>2</sub> at supercritical pressure**

**Ozone**

**Exposure of food to ozone**

**Ultrasonication**

**Exposure of foods to ultrasounds (US)**  
**US + mild temperatures (T) → thermosonication**  
**US + pressure (P) → manosonication**  
**US + T + P → manothermosonication**

**UV-C**

**Exposure of food to controlled pulses of UV rays**



## New Processing Technologies

Super Critical CO<sub>2</sub>

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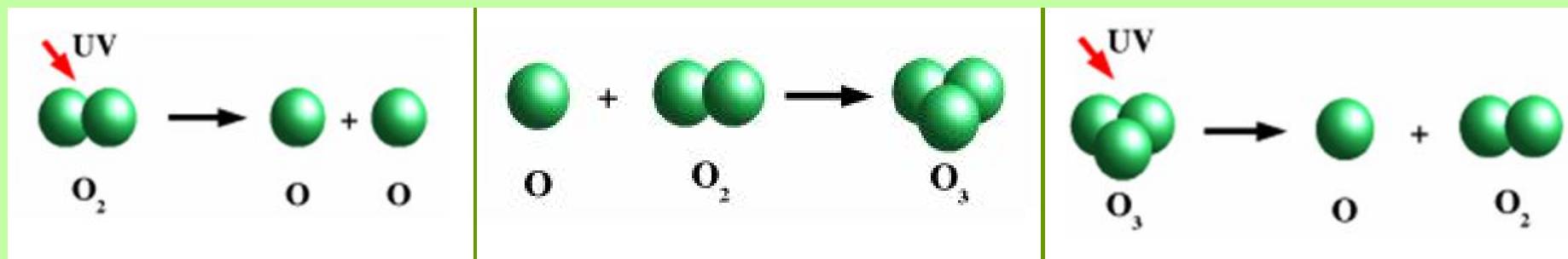
**UV-C**

**Exposure of food to controlled pulses of UV rays**



## OZONE

- Gas formed by 3 oxygen atoms
- Highly instable
- In nature it is formed by the action of sun UV light (185 nm)





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### OZONE

**-Commercially:**

Ozone generated by  
Electrical Discharge







## OZONE

- **Powerful antimicrobial agent → strong oxidant**
- **Lethal or inhibitory effect on microorganisms due to its reaction with:**
  - **intracellular enzymes**
  - **nucleic material**
  - **membrane components → destruction of coating of spores and viral capsules**





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### OZONE

#### Applications



**Water treatment**



**Food  
preservation**



**Aquaculture and  
fish farming**



**Wastewater treatment**

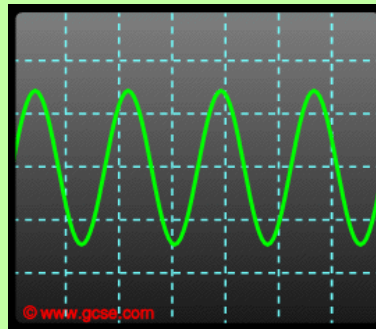
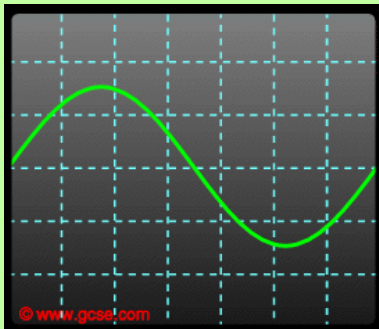


**Soil remediation**



## ULTRASOUNDS

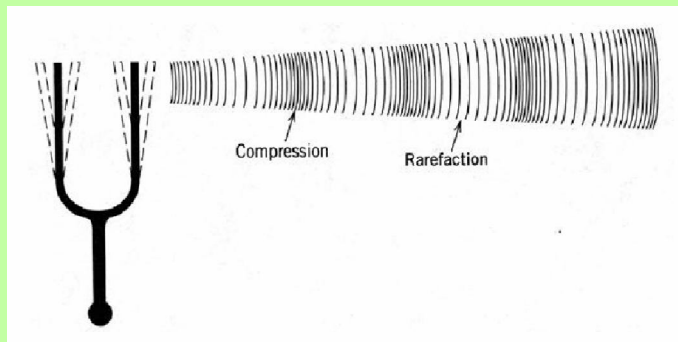
- Vibrations similar to sound waves
- Very high frequencies: 18 kHz – 500 MHz → greater than upper limit of human hearing!
- Some animals, such as dogs, dolphins, and bats, have an upper limit that is greater than that of the human ear and thus can hear ultrasound.



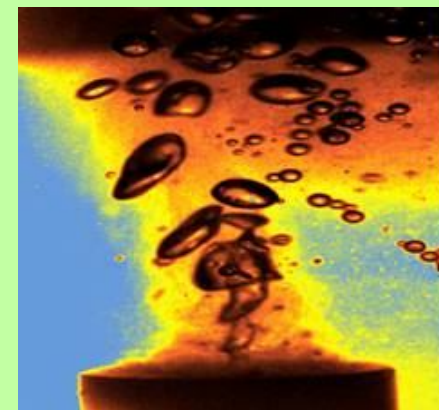


## ULTRASOUNDS

- In a biological medium: production of compression and expansion cycles  
→ **CAVITATION** phenomenon



- The implosion of gas bubbles → high temperature and high pressure spots  
→ Cell disruption → cellular death

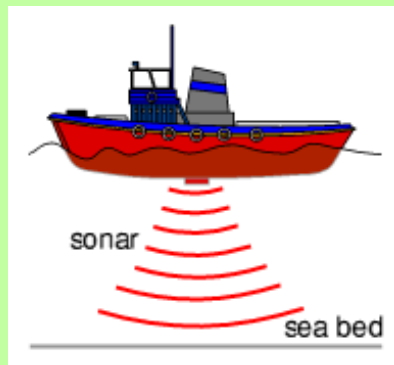






## ULTRASOUNDS

### Applications



### Navigation



### Food and Beverage Industry

quality and processing

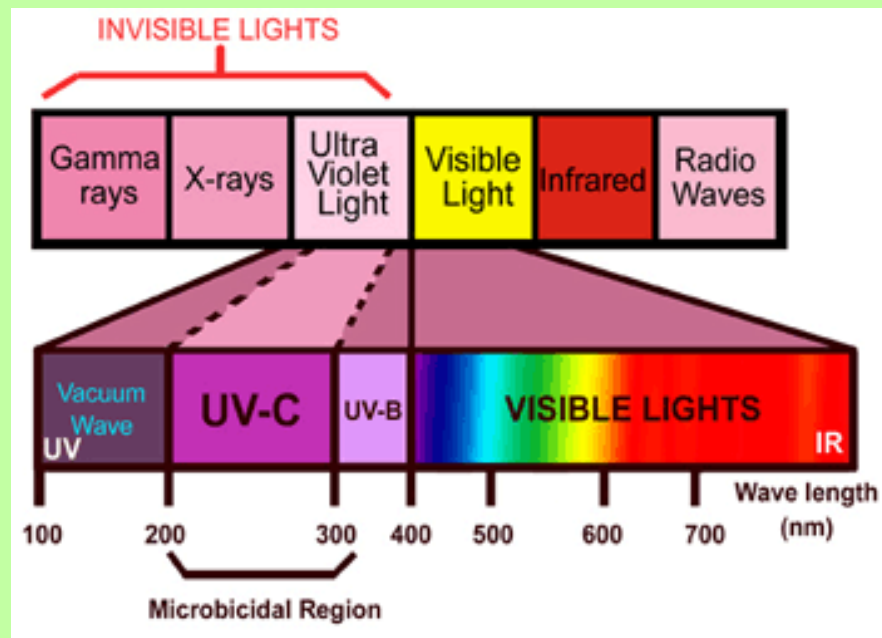


### Clinical



## ULTRAVIOLET RADIATION

- Ultraviolet light in the non-ionizing region of the electromagnetic spectrum, between X-rays (200 nm) and visible light (400 nm)

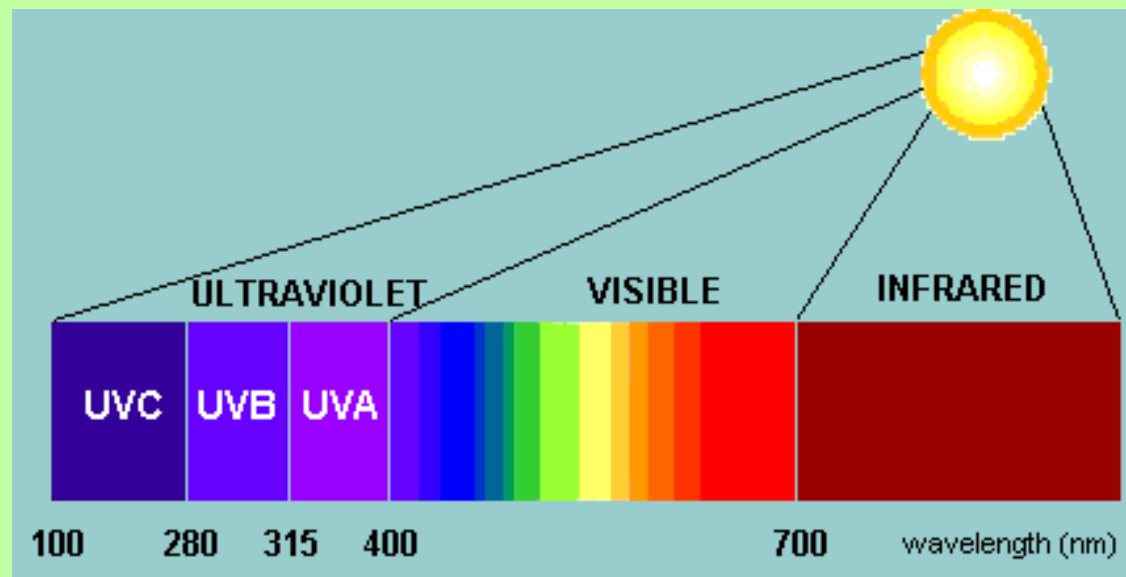




## ULTRAVIOLET RADIATION

**UV light can be divided into three regions:**

- UVA: 320-400 nm – therapeutic effects (dermatological);**
- UVB: 280-320 nm – sun burn and plant damage**
- UVC: 100-280 nm – dangerous to life – maximum lethal effect at 254 nm**

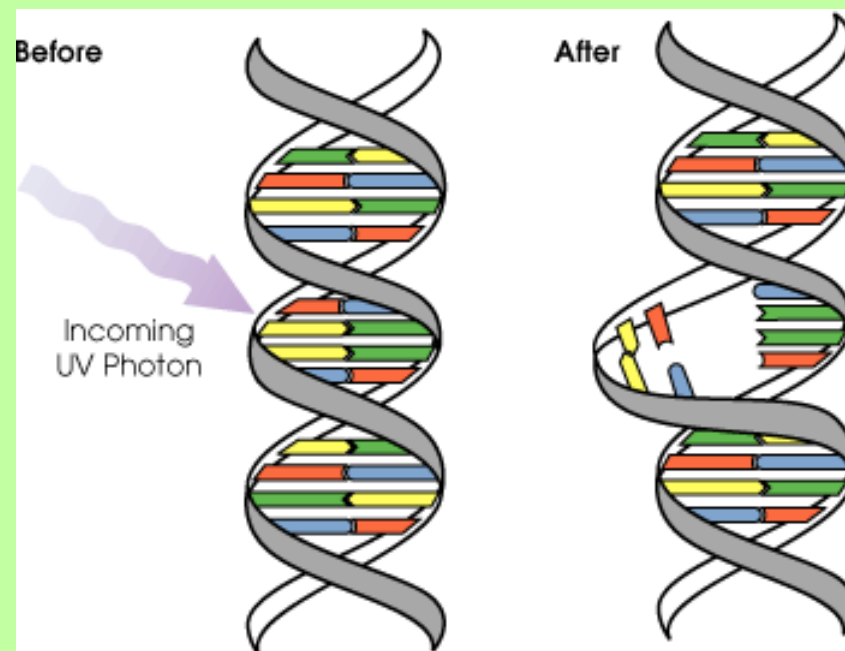
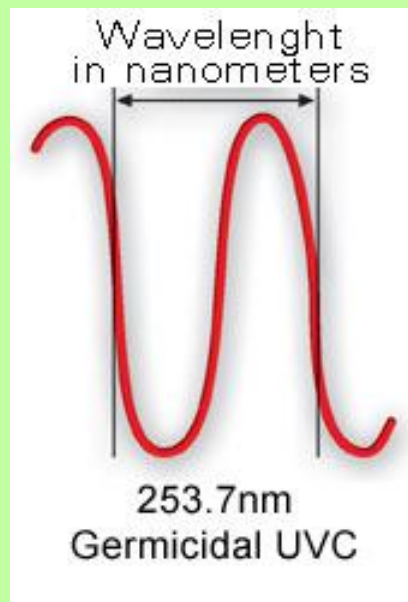




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## ULTRAVIOLET RADIATION - UVC

**Lethal effect (254 nm) due to its destroying action on DNA chains → decreasing or inactivation of vital functions of cells**







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## ULTRAVIOLET RADIATION - UVC

### Applications



**Indoor air  
sterilization**



**Food  
preservation**



**Water treatment**



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## EMERCON

“NEW PROCESSING TECHNOLOGIES FOR FROZEN  
FRUITS AND VEGETABLES”

### Partners:

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**INETI (Lisbon)**

**ESTG-UALG (Algarve)**

**FRIP (Aveiro)**





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New Processing Technologies for Frozen Fruits and Vegetables  
(Projecto AGRO, 2º concurso de 2003, código nº 822)  
AGRO - Projecto do Programa Operacional Agricultura e Desenvolvimento  
Instituto Nacional de Investigação Agrária

EXECUTION DATE: 01/01/2004 a 31/12/2006



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## Products



Strawberry



Red bell pepper



Watercress



Brocoli



Courgette / squash



pumpkin



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### Technologies



Ozone



Ultrasounds



UV-C

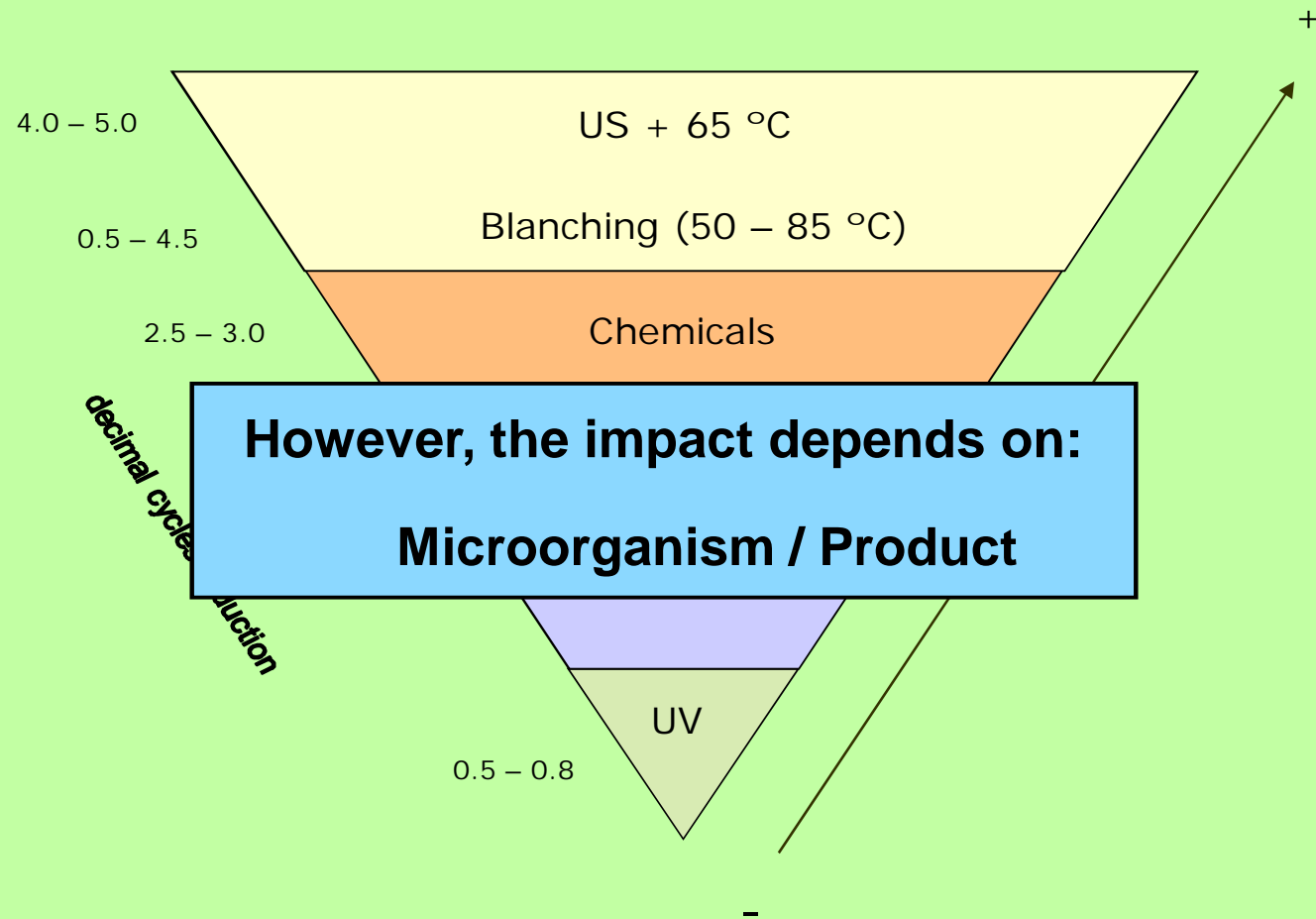




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### SAFETY (total mesophyls)

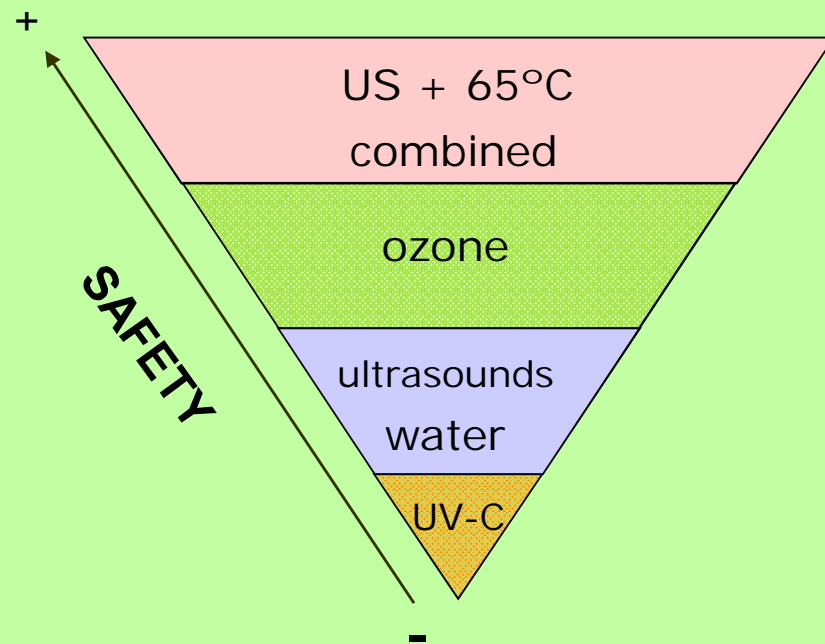




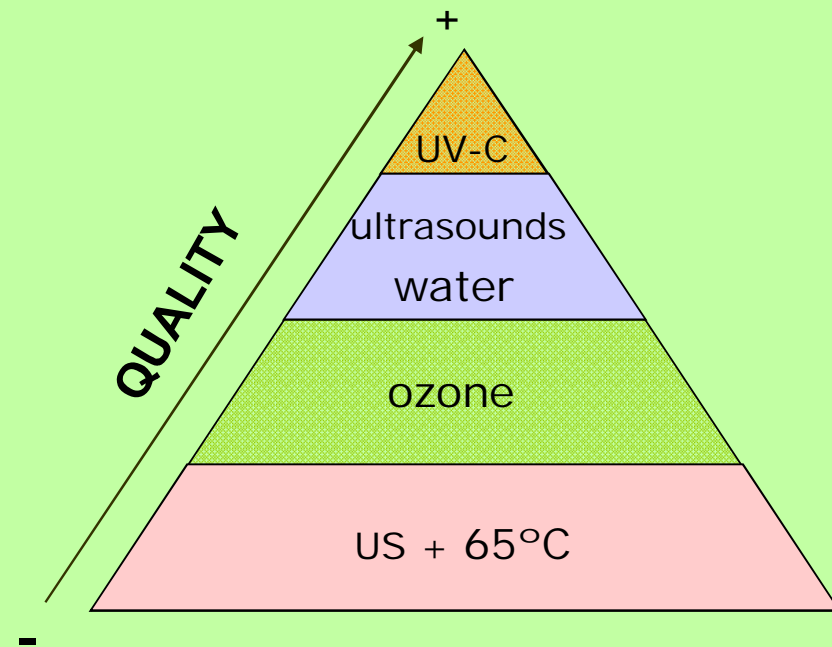
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### SAFETY



### QUALITY



Compromise: safety + quality



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THANK YOU

