

FDE 447

COLD PRESERVATION TECHNOLOGY

Content:

- *Cold storage conditions of foods
- *Chilling injury
- *Physiological principles

Cold storage conditions of foods

Refrigeration of foods involves cooling only without phase change.

Three factors are important for refrigeration of fruits and vegetables.

- Temperature
- Humidity
- Rate of air flow

Refrigeration of fruits and vegetables

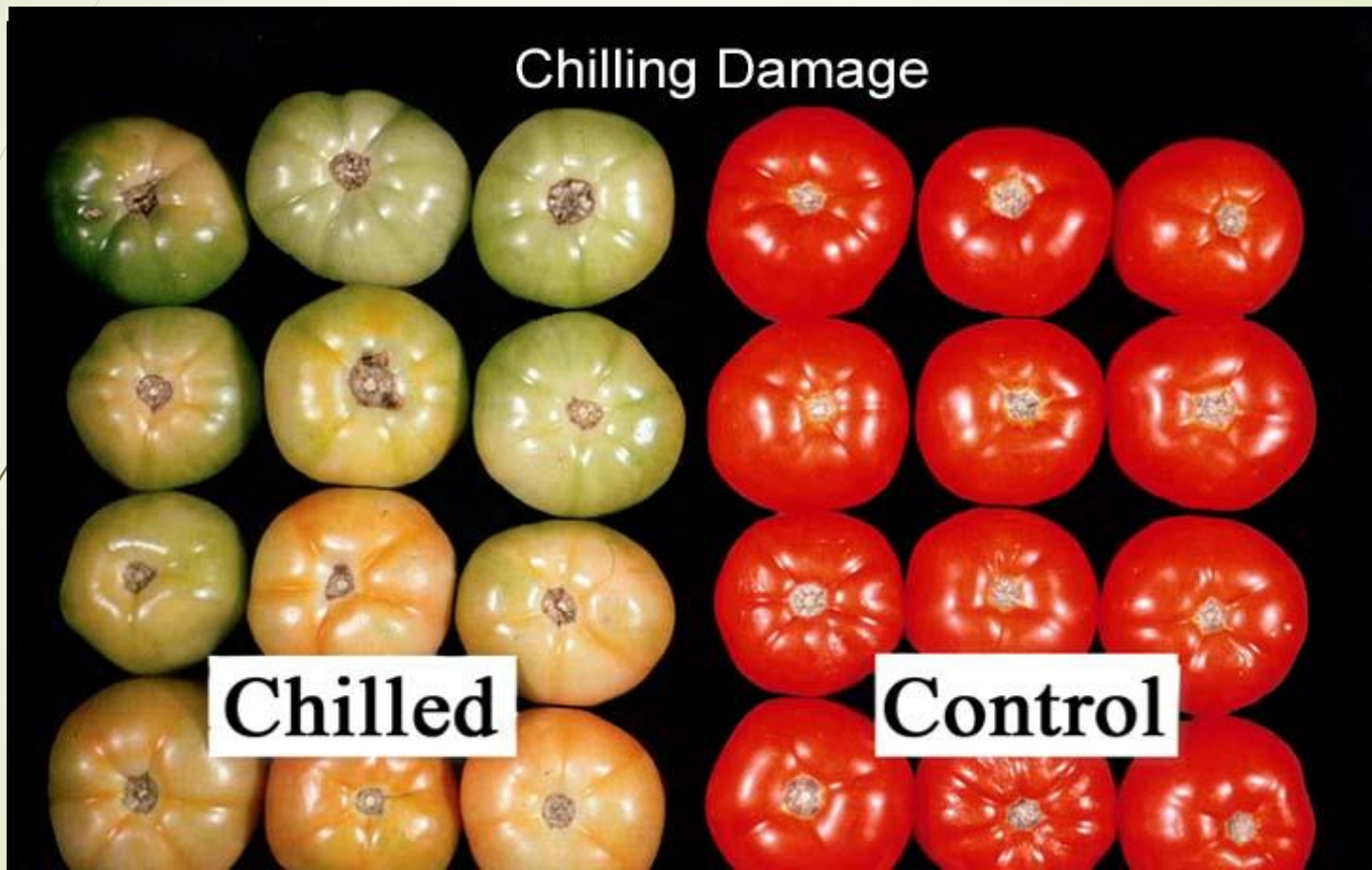
- ▶ The optimum storage temperature of most fruits and vegetables is about 0.5 to 1°C above their freezing point.
- ▶ But this is not the case for some fruits and vegetables such as bananas and cucumbers that experience undesirable *physiological changes*, when exposed to low temperatures, usually between 0 and 10°C.
- ▶ The resulting tissue damage is called the **chilling injury**.

Chilling injury is characterized by:

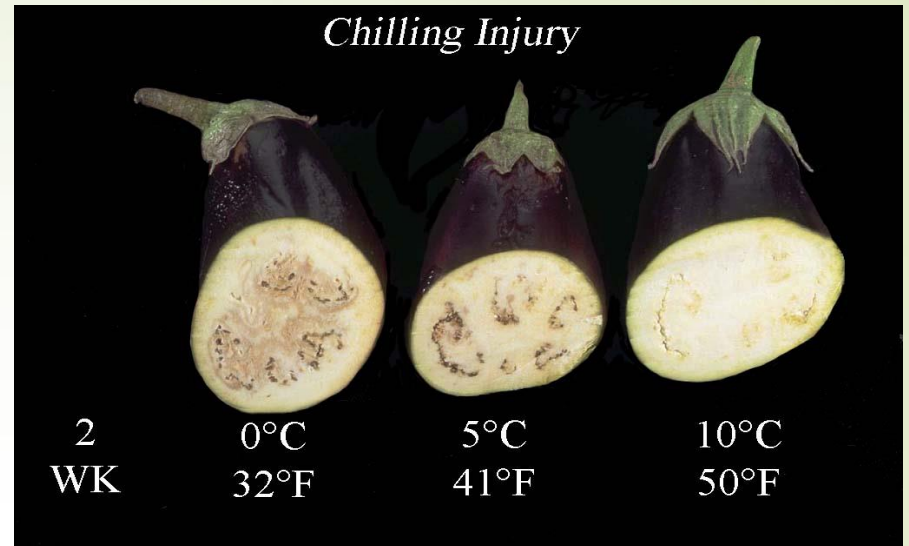
4

- Internal discoloration
- Soft scald
- Skin blemishes
- Soggy breakdown
- Failure to ripen



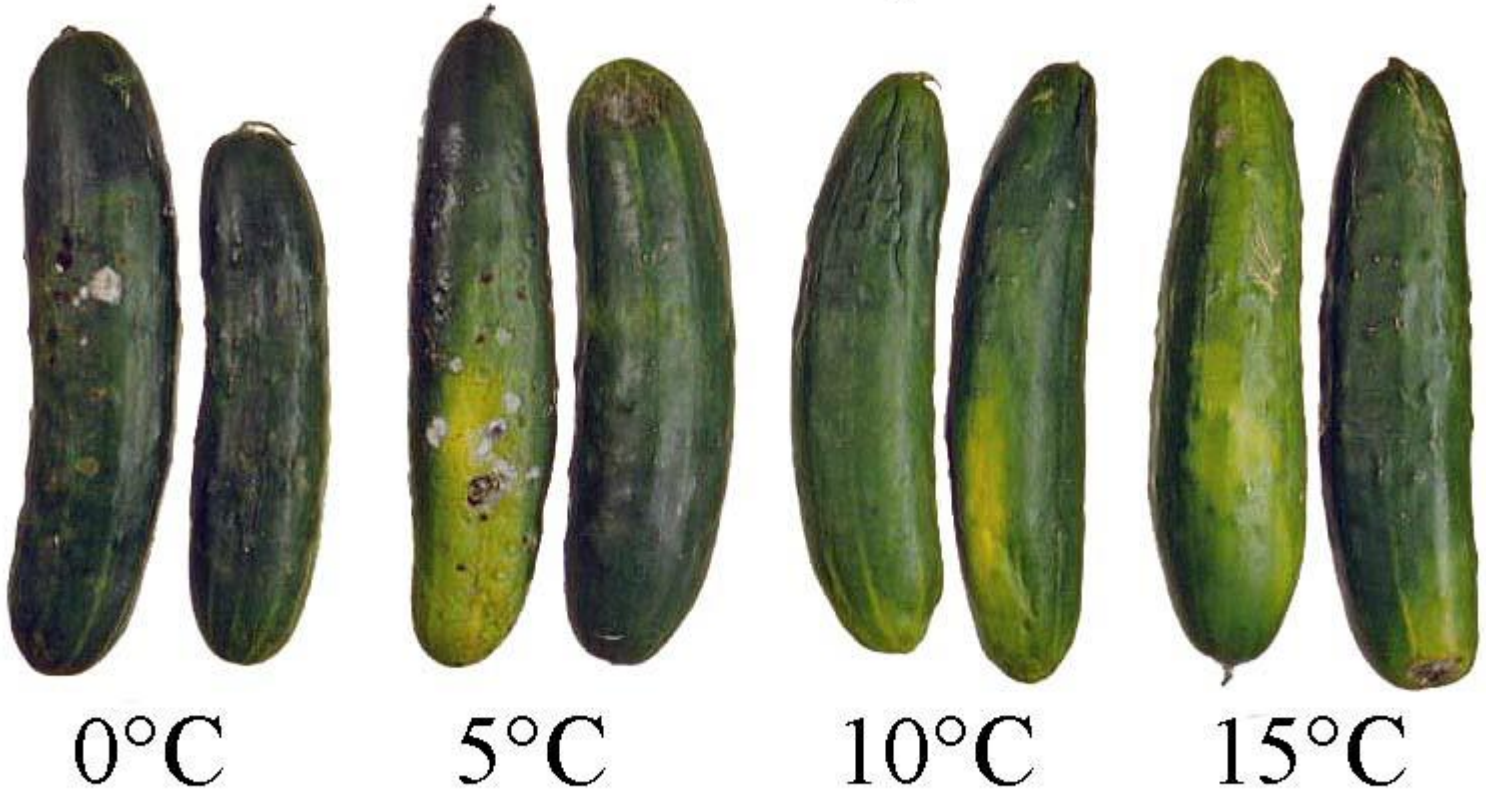


Storage at 0-2°C



Cucumber

9 d storage + 5 d @ 20°C



Some vegetables susceptible to chilling injury and the lowest safe storage temperature

Vegetable	Lowest safe temperature, °C
Cucumbers	10
Eggplants	7
Casaba melons	7 to 10
Watermelons	4
Okra	7
Sweet peppers	7
Potatoes	3 to 4
Pumpkins	10
Hard-shell squash	10
Sweet potatoes	13
Ripe tomatoes	7 to 10
Mature green tomatoes	13

Refrigeration of fruits and vegetables

9

- ▶ Fruits and vegetables are frequently cooled to preserve preharvest freshness and flavor, and to extend storage and shelf life.
- ▶ Deterioration of fruits and vegetables during storage depends largely on temperature.

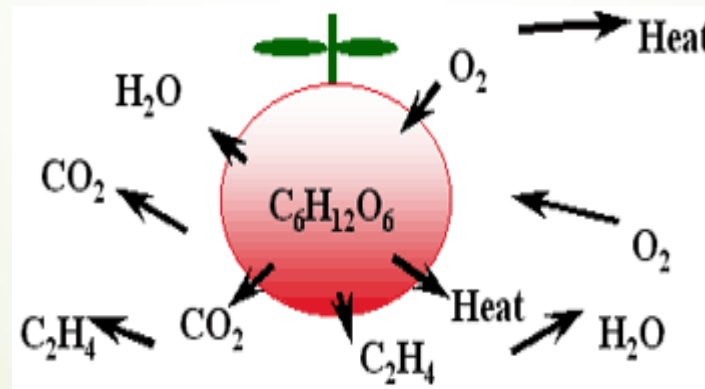
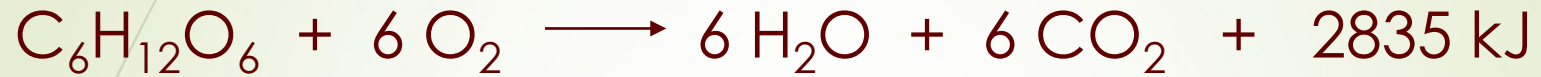
Physiological principles

10 The most important sign of life is that they take in oxygen and give off carbon dioxide.

- All these vital activities in fruits and vegetables are called «metabolism».
- Metabolism continues fast or slow depending on the environmental conditions.
- Meanwhile, the substances stored in the product are consumed.
- After a while, as in every living thing, the structure of fruits and vegetables deteriorates as a result of natural aging and death occurs.
- Chemical and biochemical events can no longer be controlled.
- Resistance to microorganisms ends, microorganisms multiply and microbial deterioration begins.

Respiration and transpiration

11 Respiration:



- Respiration generates heat as sugars, fats, and proteins in the cells of the crop are oxidized.
- The loss of these stored food reserves through respiration means decreased food value, loss of flavor, loss of salable weight, and more rapid deterioration.
- The respiration rate of a product strongly determines its transit and postharvest life.
- The higher the storage temperature, the higher the respiration rate will be.

Respiration

13

Slow breathing products

- ❑ Example: Onions, potatoes, grapes

Rapid breathing products

- ❑ Example: Peas, beans, strawberries



Relationship between respiratory rate and storage life

14

- ▶ The higher the respiratory rate of a product, the shorter its storage life (Fig. 1)
- ▶ The most important factor affecting respiratory rate is temperature.
- ▶ As the ambient temperature rises up to 37°C, the respiratory rate increases, and accordingly, the heat emitted by the product increases.
- ▶ As the ambient temperature decreases, the respiratory rate also decreases.
- ▶ Accordingly, the storage life of fruits and vegetables can be increased by lowering the storage temperature.

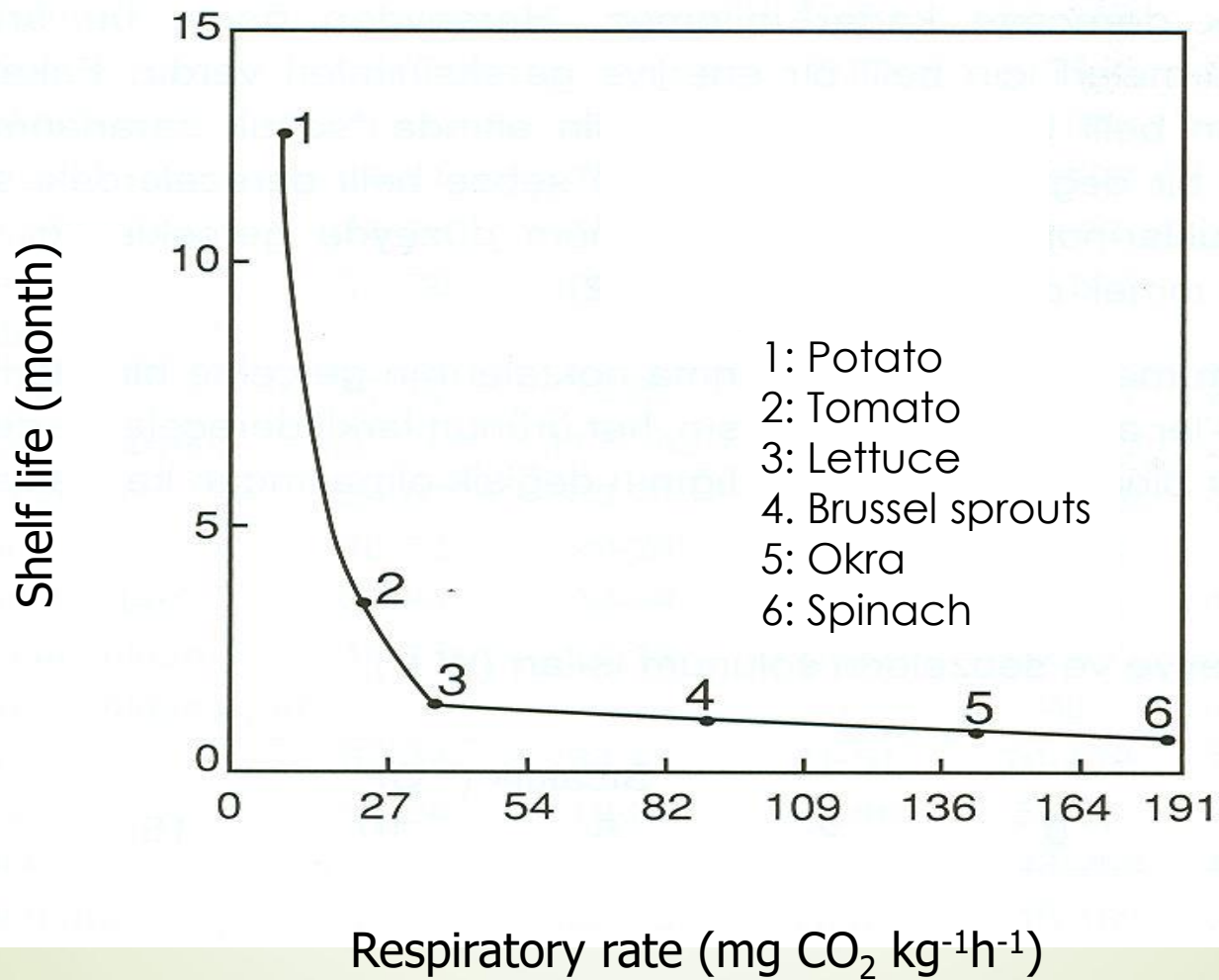


Fig. 1 Relationship between respiratory rate and storage life

- In cold storage, the respiratory heat emitted by fruits and vegetables must be constantly removed from the storage.
- Respiratory temperature values of fruits and vegetables are used to determine the cooling capacity of the warehouse.
- Respiratory heat is the amount of heat released by 1 ton of product.
- Its unit is W/t.
- As the temperature decreases, the respiratory rate slows down (Table 1).
- With frostbite, breathing stops completely. Accordingly, the respiratory rate should be at its lowest at temperatures close to the freezing point.

Table 1. Respiratory heat of some fruits and vegetables (W/t)

17

Fruit/vegetable	Temperature (°C)					
	0	2	5	10	15	20
Pear	8-11	11-22	17-42	23-70	83-126	94-218
Apple	10-18	14-20	15-32	40-60	53-92	60-125
hazelnut	2	2	5	10	10	15
Green bean	57-70	78-83	105-122	163-207	265-413	396-578
Spinach	61-83	78-119	129-199	210-314	425-525	632-900
Potato	11-26	11-24	17-20	20-30	30-55	24-44

Other factors affecting respiratory rate

18

Some metabolic products of fruits and vegetables

- -Acetylene
- -Ethylene
- - butylene