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QUALITY, CURING & SMOKING OF PORK MEAT

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ESALQ/USP

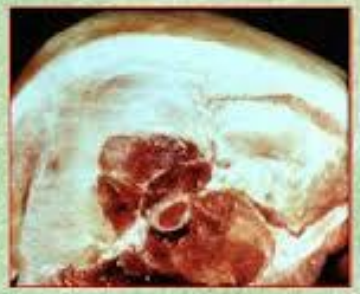
OBJECTIVES

- Know the production of pig in Brazil
- How to differentiate PSE, DFD and normal pork meat
- Learn the cure & smoking processing

- Major producers worldwide

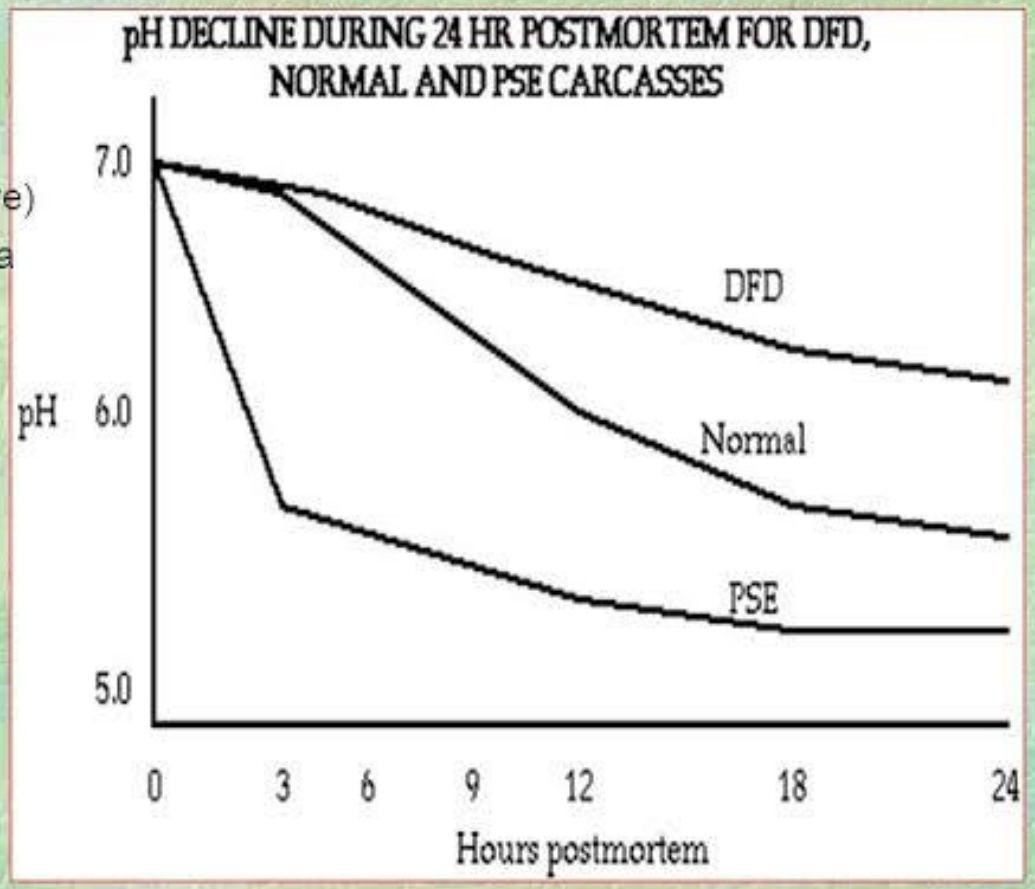
  - China, US, Brazil, Germany
  - Brazil is the four largest producer of pork meat in the world
  - Brazil produced annually 3.3 million tons pork meat

pH OF PSE, DFD AND NORMAL PORK MEAT

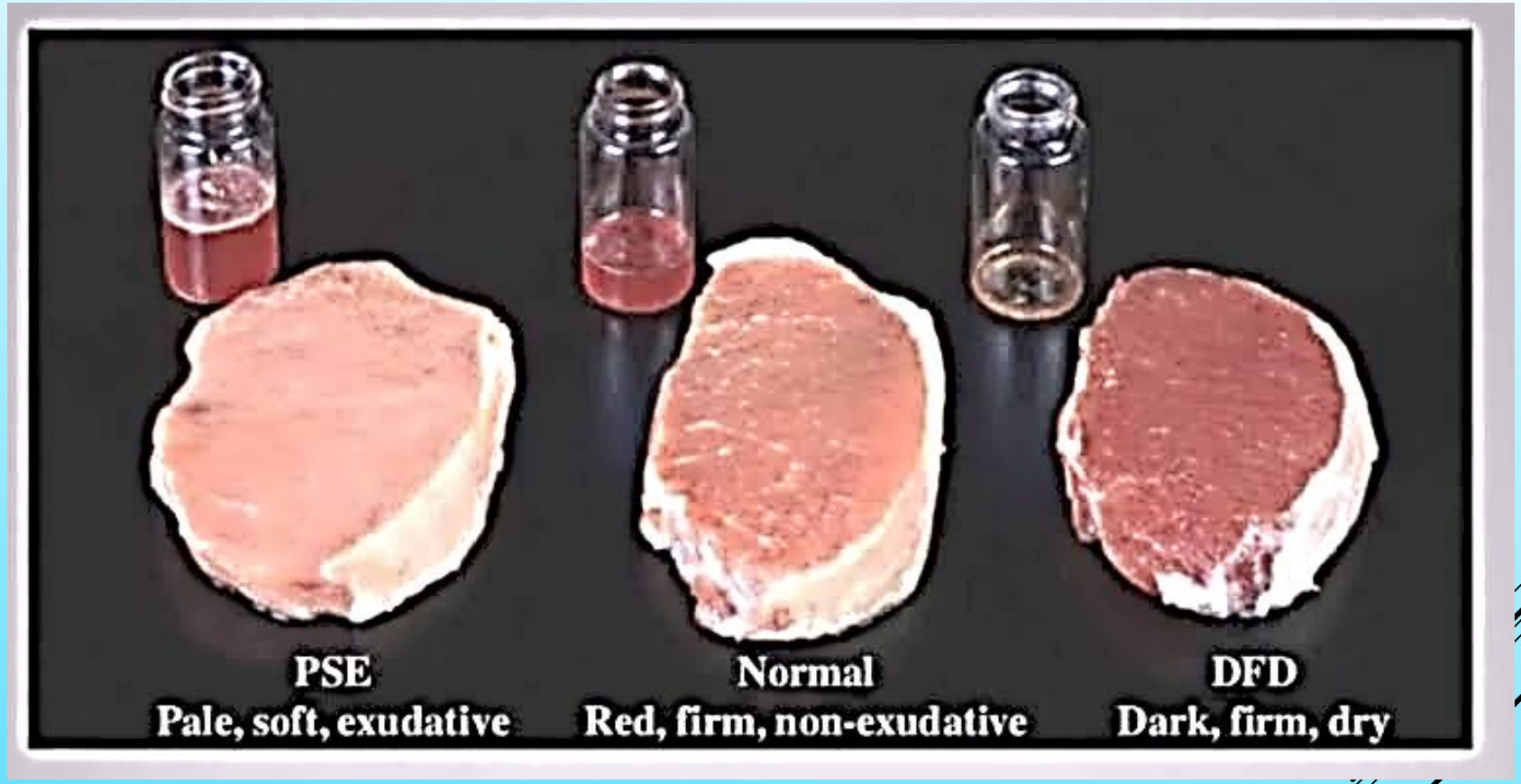


PSE (pale, soft, exudative)
Pálida, flácida, exsudativa

DFD (dark, firm, dry)
Escura, dura e seca



PSE, DFD AFFECT THE FUNCTIONAL PROPERTIES OF PORK MEAT



- Water Holding Capacity (WHC)
- Color
- Texture

WHAT IS CURING?

- Curing is addition of salt, sugar, and nitrite or nitrate to meats for purpose of preservation, flavor enhancement, or color development.

- Today curing is performed more for flavor

  development than for preservation

OTHER FUNCTIONS OF CURING

- Shelf life extension
- Development of unique properties
- Resistance to rapid deterioration
- Controlling microbial growth.

CURING INGREDIENTS

- **Salt (NaCl)**
  - Contributes flavor
  - Preservative effect
  - Controls microbial growth (doesn't kill bacteria)
  - Osmosis (enhances transport of nitrate, nitrite, and sugar)
  - Can be in granular or rock forms.
  - Only difference is quantity of NaCl in the salt.

CURING INGREDIENTS

- Sugar ($C_{12}H_{22}O_{11}$)
  - Contributes flavor
  - Counteracts salt
  - Provides source of energy for nitrate converting bacteria
  - Lowers the acidity of the cure
  - Can be added in the form of:
    - Sucrose (table sugar/brown sugar)
    - Dextrose (refined corn sugar)
    - Corn syrup solids
  - Commercial cures use corn syrup solids
    - Cheaper
    - May require more to get same flavor

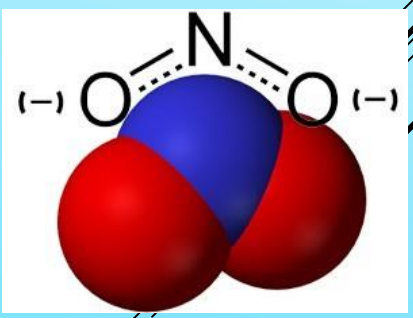
CURING INGREDIENTS

- **Nitrite ($NaNO_2$) or Nitrate ($NaNO_3$)**
  - Contributes flavor
  - Prevents warmed-over flavor (WOF) in reheated products
  - Retards development of rancidity during storage
  - Prevents growth of *C. boltulinum* in canned products
  - Bacteriostatic
  - Contributes cured-pink color to the product.

NITRITES & NITRATES

- Usually come in the form of potassium or sodium nitrites or nitrates.
- MAPA allows use of nitrate ($NaNO_3$ or KNO_3) ONLY in dry cured meats or dry sausage.
- MAPA permits use of Nitrites ($NaNO_2$ or KNO_2) in sausages and bacon
  - Ingoing nitrite level cannot exceed 150 ppm (Brazil)
    - Must be accompanied by 550ppm sodium ascorbate or sodium erythorbate
  - Residual nitrite must not exceed 40 ppm
- Nitrites and Nitrates can be carcinogenic.
  - MIT Study: 40 pounds of bacon/day

    for 40 years
- Currently seeing increase of "No Nitrite" or "Uncured" products



THE MEAT CURING PROCESS

Sodium nitrite added to meat

Resulting sodium nitrite compounds react with myoglobin in meat

Nitric oxide myoglobin formed

Application of heat

Nitric oxide myoglobin denatured

Nitrosyl hemochrome formed, providing bright pink color

CURING REACTION

- **Basic Cure Reaction (1st Step)**

  Deoxymyoglobin + Nitric Oxide = Nitric Oxide Myoglobin

  (purplish red) **(red)**

- Nitric Oxide is generated during curing sequenc

- $NaNO_3 \rightarrow NaNO_2 \rightarrow$ HONO $\rightarrow$ NO

  Nitrate Nitrite Nitrous Acid Nitric Oxide

- Nitric Oxide myoglobin in unstable
  - Color must be "fixed" by heating to 140 degrees.

CURING REACTION

- **Fixation Reaction**

  Nitric oxide myoglobin +Heat = Nitrosylhemochromagen

  (red) **(cured pink)**

  - Nitrosylhemochromagen is responsible for stable cured-pink color.
  - Very Heat Stable- pink color doesn't change with further cooking
  - Only occurs with the addition of heat

- **Overall Reaction:**Myoglobin + NO →→Nitric Oxide Myoglobin →→Nitrosylhemochromagen

  (purplish red) **(red)** **HEAT**

CURING ADJUNCTS

- Proper color development is a function of time
- Ascorbic Acid, Sodium Ascorbate and Sodium Erythorbate speed color development
- Ascorbates reduce Metmyoglobin to Myoglobin
  - Metmyoglobin is unable to combine with NO, while Myoglobin can
- Ascorbates speed reduction of HONO to NO
  - Greater quantities of NO available for production
- Treatment of cured cuts with 5-10% Ascorbic Acid
  - Effective in reducing fading of cured color in displays

ALKALINE PHOSPHATES

- Usually Sodium Tripolyphosphate
- Added to decrease shrink during curing & smoking
- Cannot exceed 0.5%
- Increase water holding capacity (WHC) of muscle proteins

WATER

- Water is “curing ingredient” when doing Cover Pickle Curing (Brine) or Injection Curing
- Disperses cure throughout meat
- Use of water reduces cost of products
  - Products with more water are cheaper
- Water remaining in retail product is “Added Water”

APPLICATION OF CURING INGREDIENTS

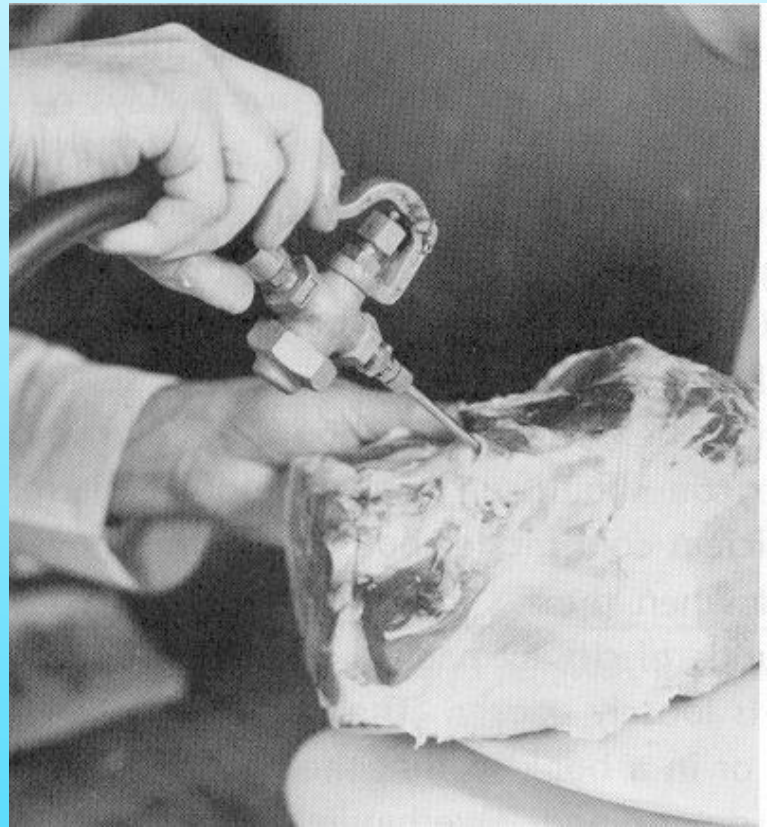
- **Dry Curing**
  - Use of salt or salt plus nitrite or nitrate
  - Dry Sugar Curing
    - Uses Sugar to overcome harshness of salt flavor
  - Both methods involve rubbing cure mixture over surface
  - Penetration of NaCl occurs through osmosis
  - Bone Sour (souring around bones) occurs in hams
    - Lack of rapid-enough salt penetration to interior
  - High levels of shrinking

APPLICATION OF CURING INGREDIENTS

- **Curing With Liquid**
  - Can either be Cover Pickle (placing meat in brine) or Sweet Pickle (sugar added to brine)
  - Penetration of cure occurs via osmosis
  - More uniform distribution of cure
  - Can Result in Bone Sour
  - Can result in yeast growth

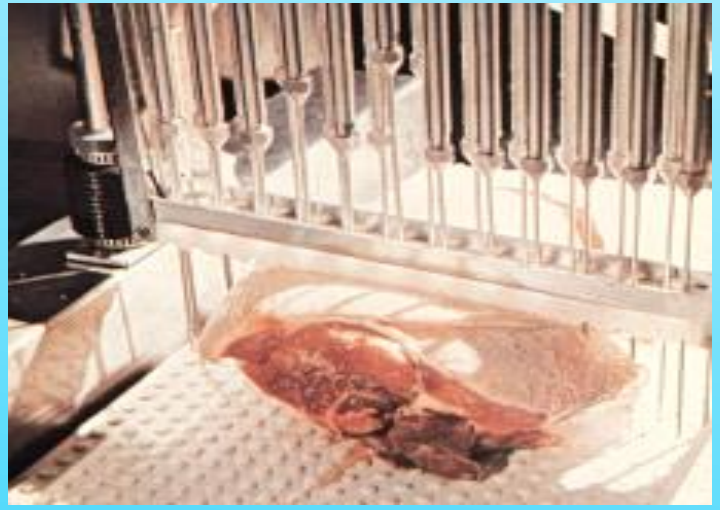
Injection Curing

- Three forms of injection curing
  1. Stitch or spray pumping
     - Cure directly injected into meat with needles
  2. Artery Pumping
     - Accomplishes best possible distribution of cure
     - Cure dispersed via capillaries



3. Multi-needle Machine Injection

- Most commercial facilities use
- Rapid penetration of cure into meat (reduce spoilage)
- Less spoilage and shrinkage
- Not conducive to development of typical flavor, aroma, and texture



MASSAGING & TUMBLING

- **Massaging and Tumbling occur after Pumping**
  - Extract muscle proteins to bind the muscles together
  - Allow for increased pickup & retention of moisture
- **Function of Massaging and Tumbling**
  - Disruption of Tissue Structure
  - Hastening of Cure-Ingredient Distribution
  - Solubilization of muscle proteins
- **Massaging**
  - Relies on frictional energy
  - Minimizes the tearing of muscles
  - Minimizes particle size reduction
- **Tumbling**
  - Relies on impact energy
  - Extracts myofibrillar proteins

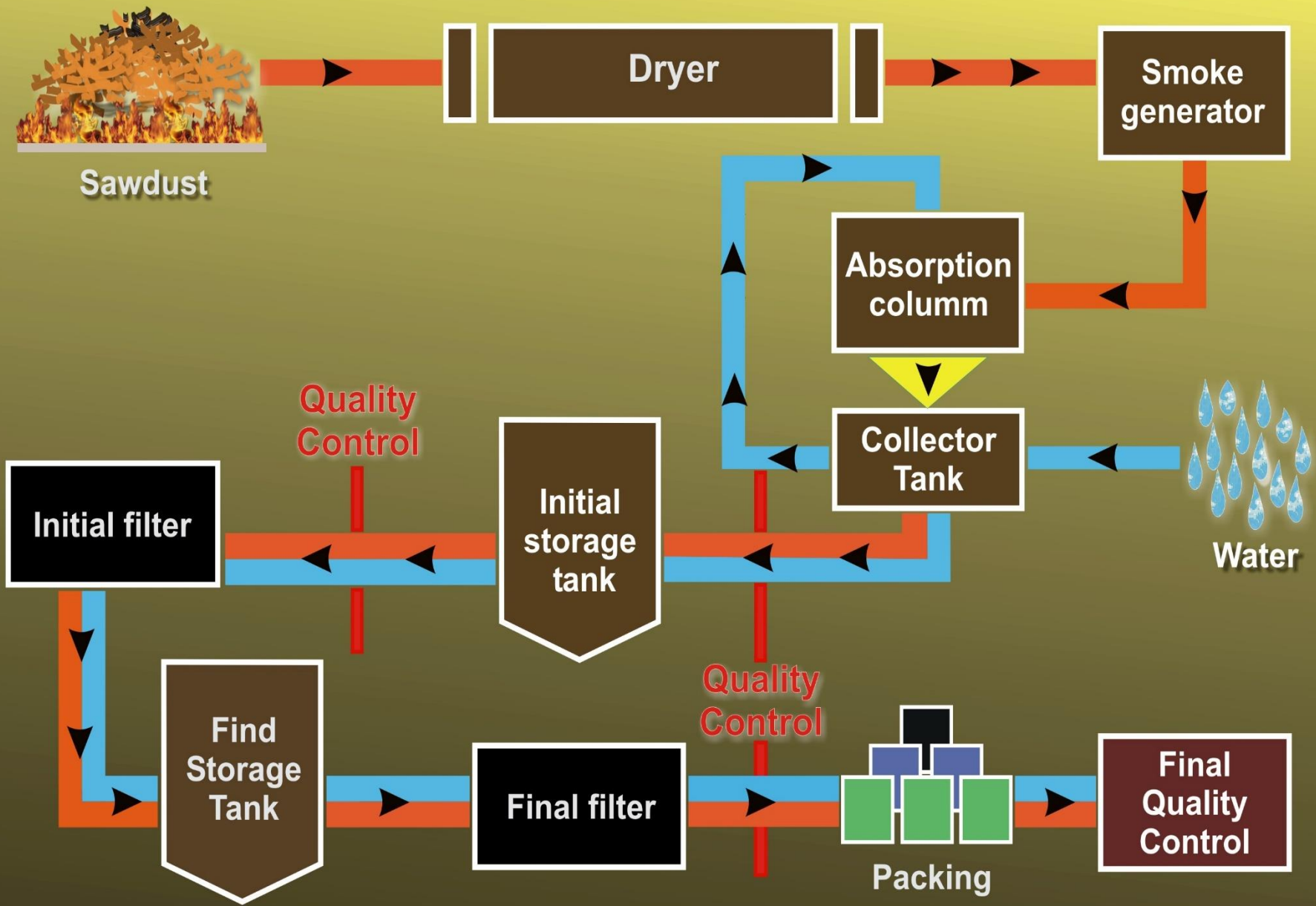
SMOKING OF MEAT PRODUCTS

- Materials used for smoke come from hardwood sawdust or chips
  - Softwood products result in sooty deposit.
- Over 200 components comprise smoke
  - At least 80 have been identified
  - Almost all exhibit bacteriostatic or bacteriocidal properties
- Smoke consists of two parts
  - Dispersed phase- consists of parts that are 2-3 micrometers in size
    - Tars, soot, charcoal, and resins
  - Gaseous phase- Not visible
    - Phenols, acids, and carbonyl compounds

SMOKING OF MEAT PRODUCTS

- Benefits of Smoking
  - Flavor and Odor Enhancement
  - Color Development on Outside of Product
  - Preservation of the product
- Liquid smoke- widely used in industry
  - Wood combustion products dissolved in water
  - Cheaper and quicker than the smokehouse process


More processors are turning to liquid smoke. One estimate has seven of 10 processors using liquid smoke in meat products.
500 ml
300
200
100


Sawdust
Dryer
Smoke generator
Absorption columm
Collector Tank
Water
Quality Control
Initial filter
Initial storage tank
Find Storage Tank
Quality Control
Final filter
Packing
Final Quality Control

Application of liquid smoke