Basic Meat Chemistry

Prof Ockerman 2x2 slides originally constructed in the 60's

Some of script was added in 2015

The Ohio State University

BASIC MEAT CHEMISTRY

MEAT COMPOSITION

MEAT PIGMENTS

CONVERSION OF MUSCLE TO MEAT

Basic Chemistry of Processed Meat

Meat Composition

Rigor Mortis

After Holding
Rigor & Water Holding

Heating Meat

Meat Pigments and Color

Meat Emulsions

MEAT COMPOSITION

WATER

PROTEIN

FAT

OTHER

A. WATER

60-75% LEAN TISSUE

1-10% FAT TISSUE

MYOFIBRILLAR - SALT SOLUBLE

CONTRACTILE APPARATUS

STRUCTURE PROTEINS

ACTIN AND MYOSIN - 80%

B. PROTEIN

16 - 22%

MYOFIBRILLAR (55)

- SALT SOLUBLE

SARCOPLASMIC (30)

- WATER SOLUBLE

STROMA (15)

- SALT INSOLUBLE

MYOFIBRILLAR

CONTRACTILE PROTEINS

ACTIN

MYOSIN

Sarcoplasmic – Water Soluble

Plasma of Cell

Enzymes

Myoglobin

STROMA - SALT INSOLUBLE

CONNECTIVE TISSUE

CONNECTS MUSCLE CELLS TO

COLLAGEN

STROMA PROTEINS

COLLAGEN CONNECTIVE TISSUE

MOIST HEAT
AND TIME

GELATIN

ELASTIN

PROTEIN DENATURATION

HEAT

DRYING - COLLAGEN HARDEN

ACID

C. FAT

1 - 13%

DEGREE OF UNSATURATION

OXIDATION → RANCIDITY

SPONTANEOUS

Lipids

Fatty acids determine characteristic

Saturation and chain length

Determine melting point

Oxidation – Rancidity

Spontaneous, Time, Temperatures & Antioxidants

Off odors and flavors

Factors Affecting Emulsion Stability

1. Water Holding Capacity
   More Capacity – More Water Holding – More Stability

"EMULSION" STABILITY

- WHC
- FORMULATION
- MECHANICAL TREATMENT

B. HYDRATION CAPACITY (WHC)

BOUND VS. FREE WATER

EFFECT OF SALT AND PHOSPHATE

Bound water as % of meat

Water holding Characteristics

pH – Net charge – isoelectric point

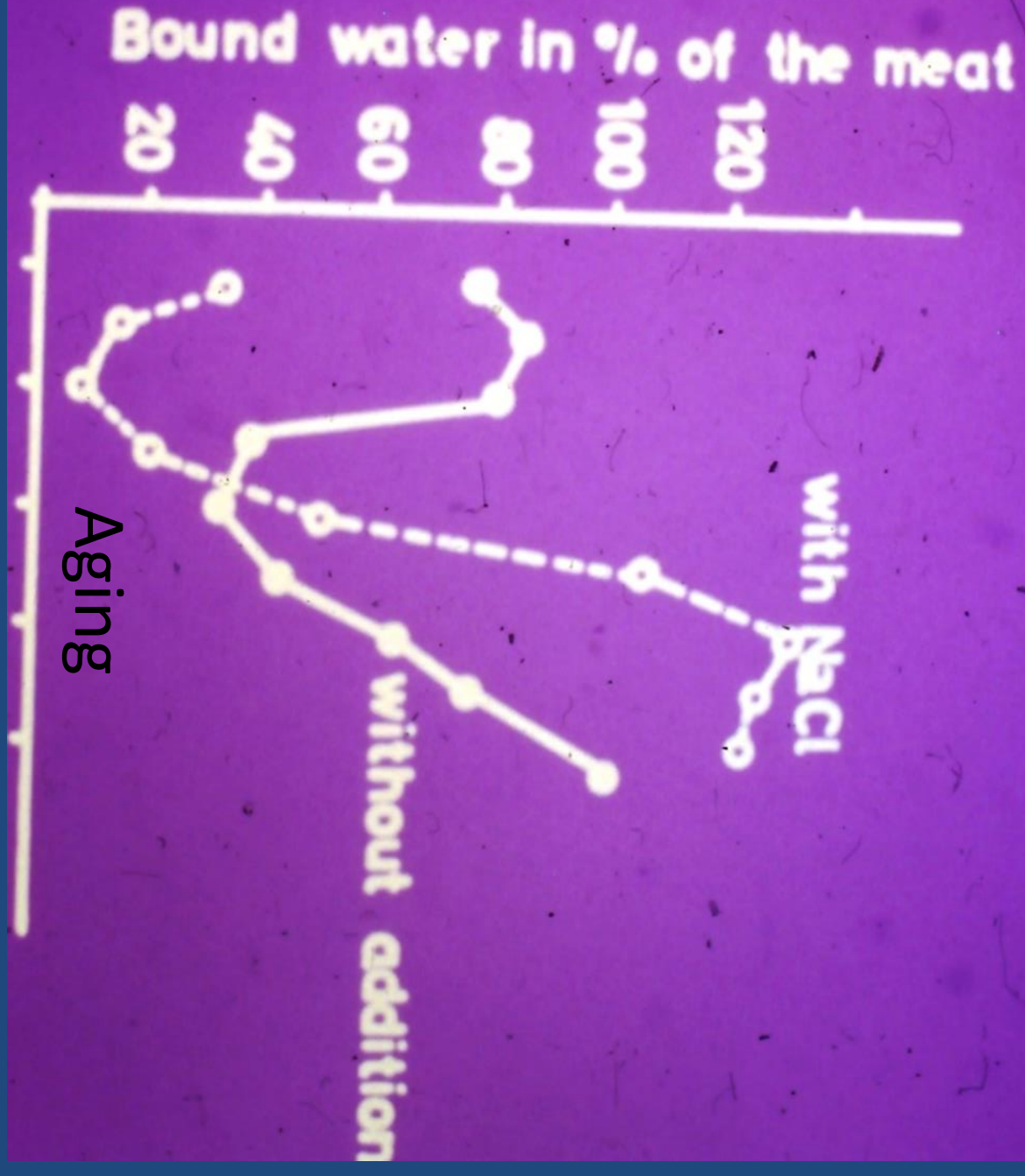
Space in Protein

Solubility of Protein

WHC – Salt Effects

Changes Isoelectric Point
Increases negative Charge
Increases Protein Space
Increases Protein Space

Bound Water as % of Meat



Pigments

A. Myoglobin(Purple)

B. Oxymyoglobin (Red)

C. Nitrosylmyoglobin (Red)

D. Denatured Metyoglobin (Brown)

WHC – Capacity – Salt Effects

Changes Isoelectric point
Increases Negative Charge
Increases Protein Space
Increases Protein Space
Increases protein Solubility

Meat Emulsions

Multiphase –System Consisting of a Desperation of Solids in a Liquid, But the dispensation is not Homogeneous

C. MEAT EMULSIONS

Liquid Phase --

Water, Protein, Salt

Solid Phase --

Fat

Emulsion Formation

Myofibrillar Proteins are Partially Solubilized by Chopping with salt and water. Fat is Chopped Into Small Particles and is Coated by Soluble Protein Emulsion. Is stable if Fat Does Not Separate During Cooking.

Liquid Phase – Solution of Salt and Proteins in Which Insoluble Proteins, Muscle Proteins and Connective Tissue are Dispersed = Protein Matrix

Solid Phase - Fat Particles Dispersed in Matrix.

D. Product Formulation

Protein to Ice Water Ratio.

Matrix Protein Volume to Fat Ratio.

Salt Content.

Other Additives – Binders.

MECHANICAL TREATMENT

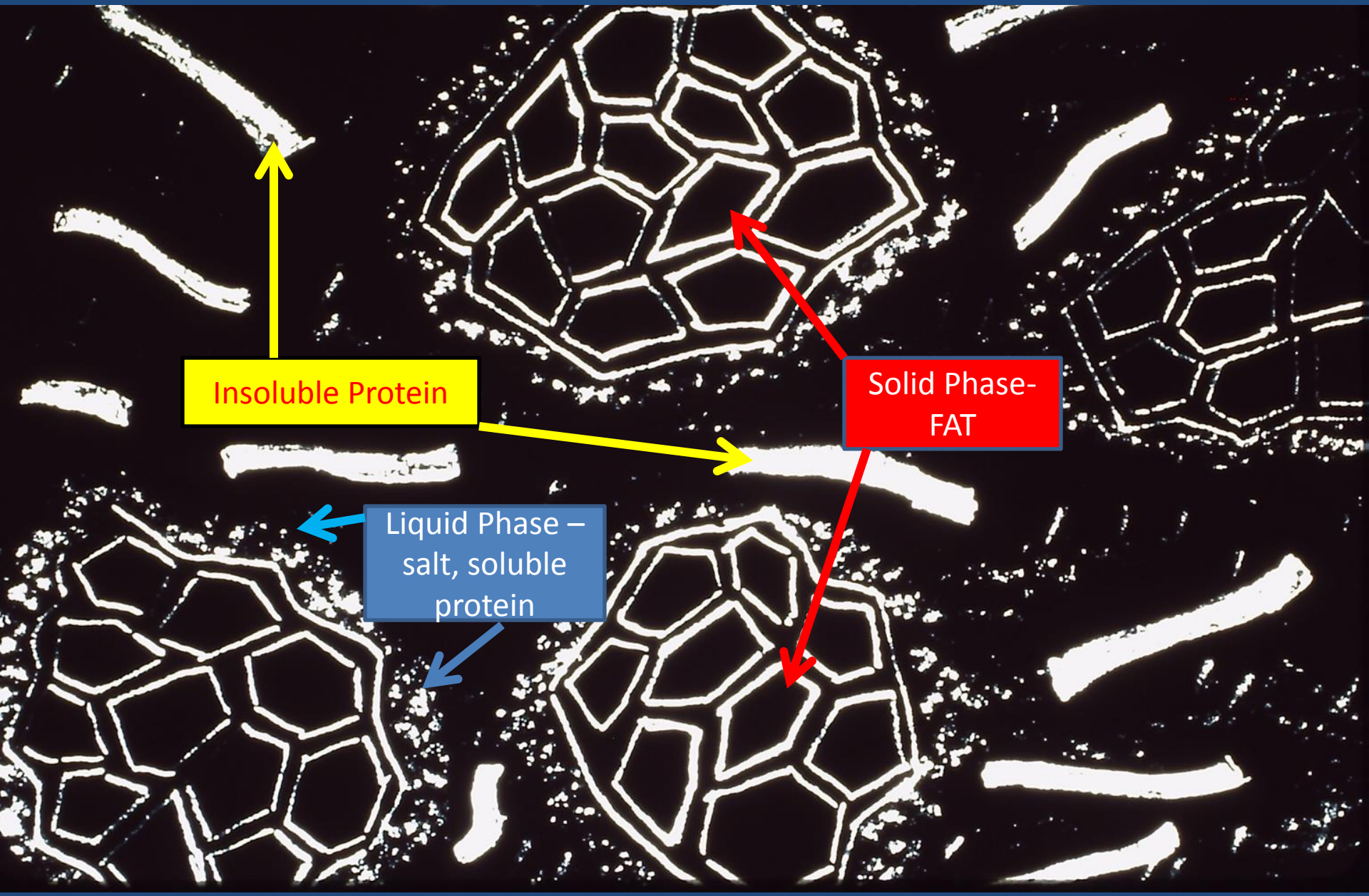
ORDER OF INGREDIENTS

CHOPPING TIME AND TEMPERATURE

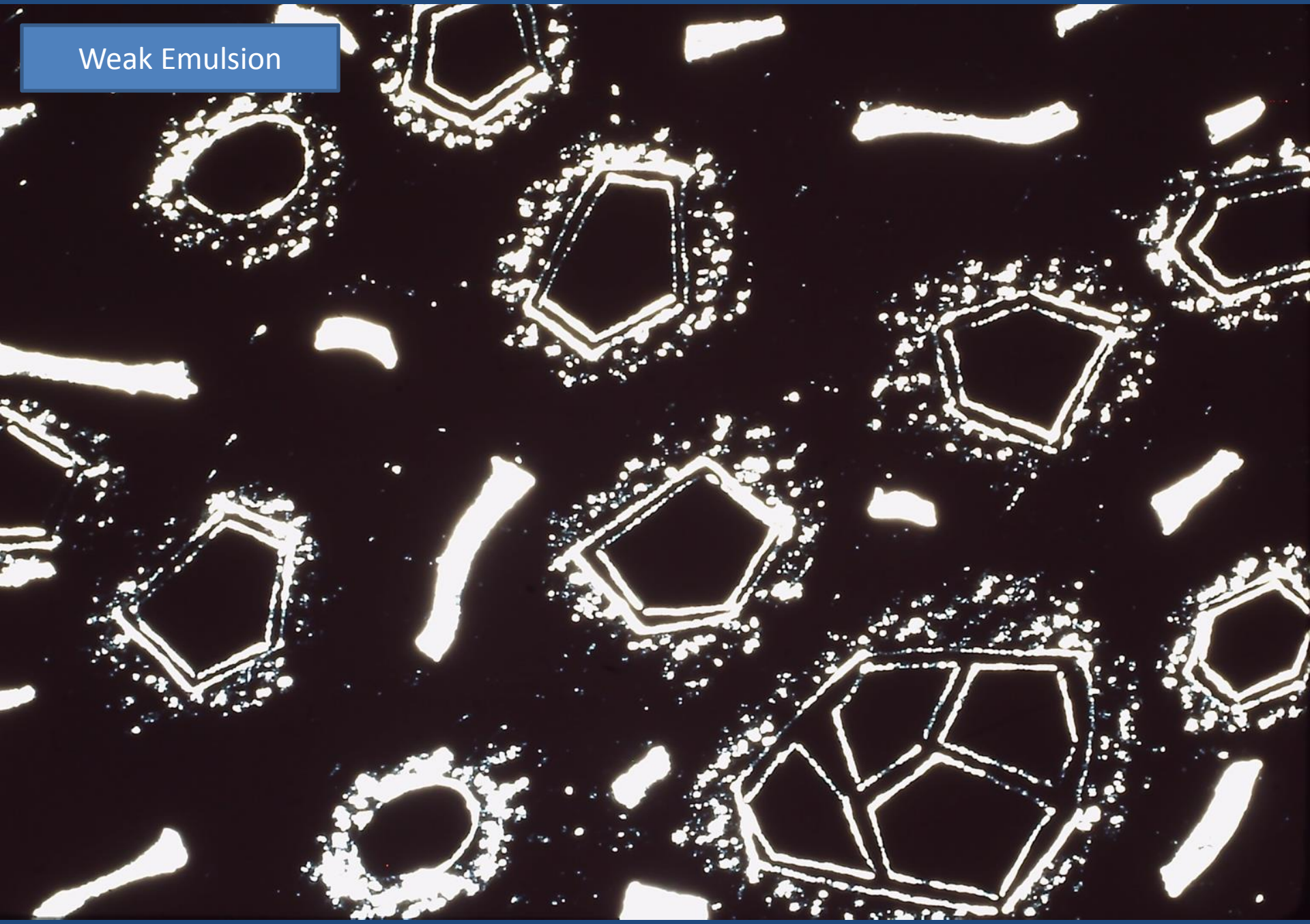
DISINTEGRATION OF MEAT FIBERS

DISINTEGRATION OF FAT PARTICL

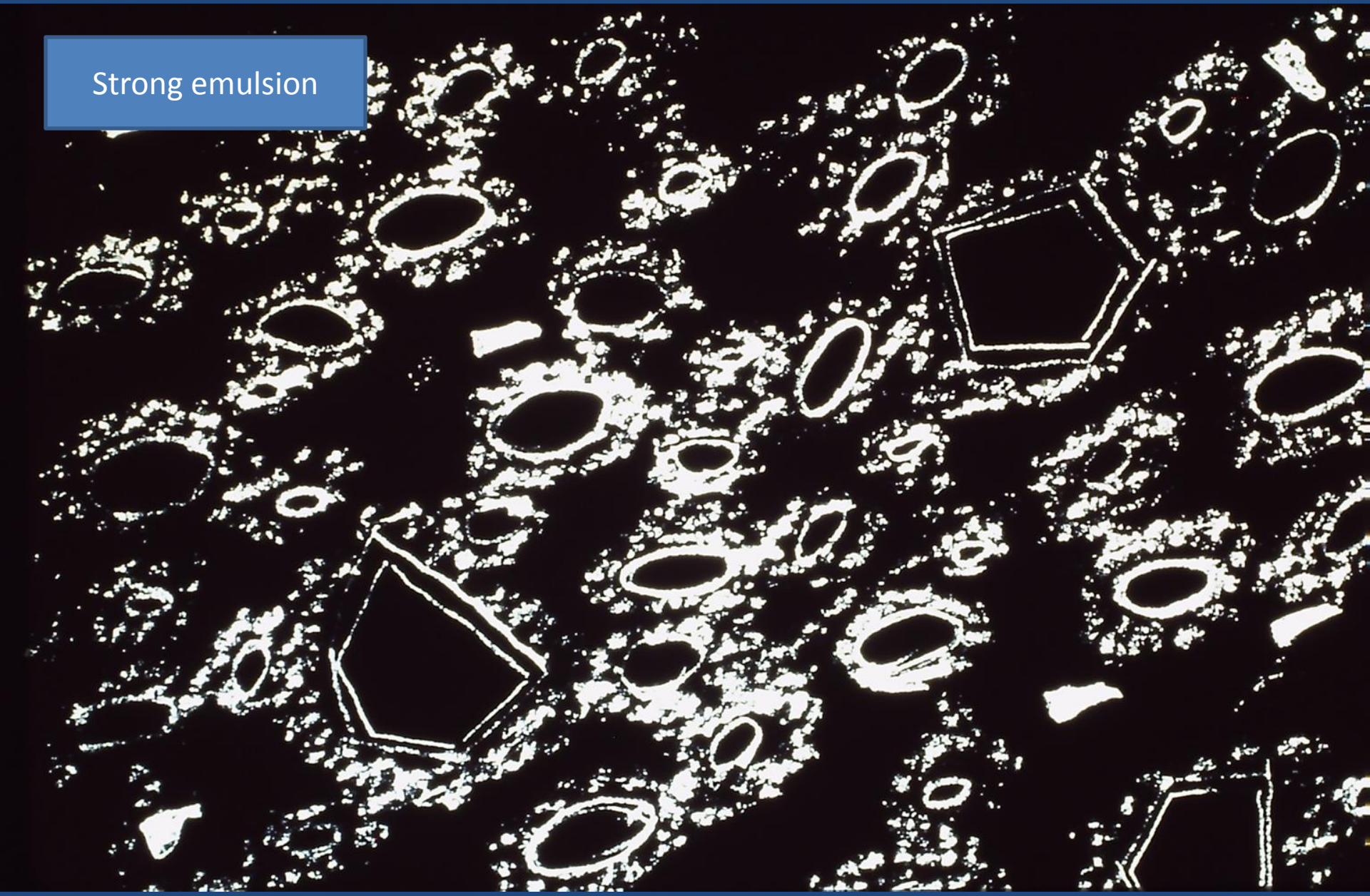
SURFACE AREA OF FAT

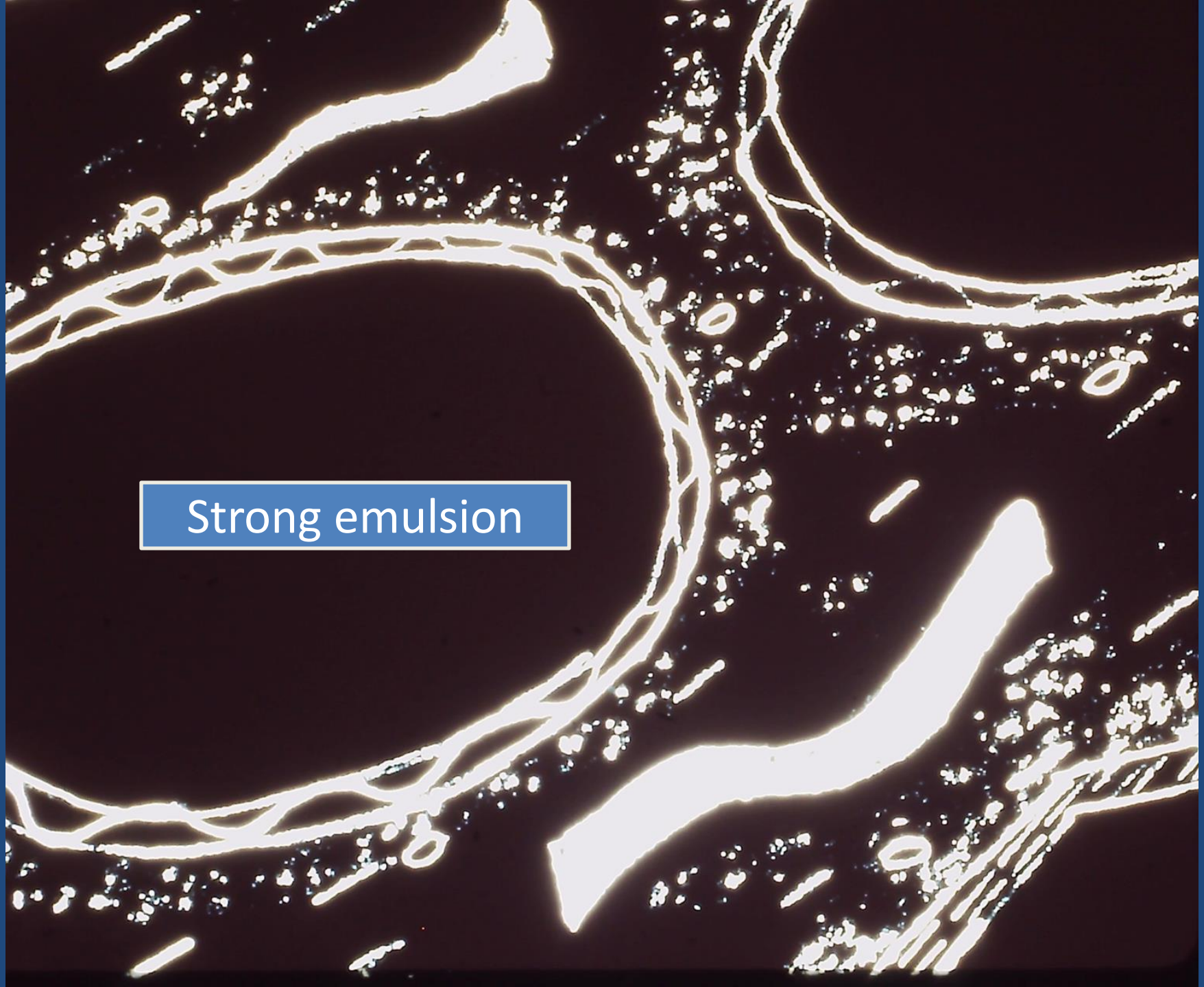

Insoluble Protein
Solid Phase- FAT
Liquid Phase – salt, soluble protein

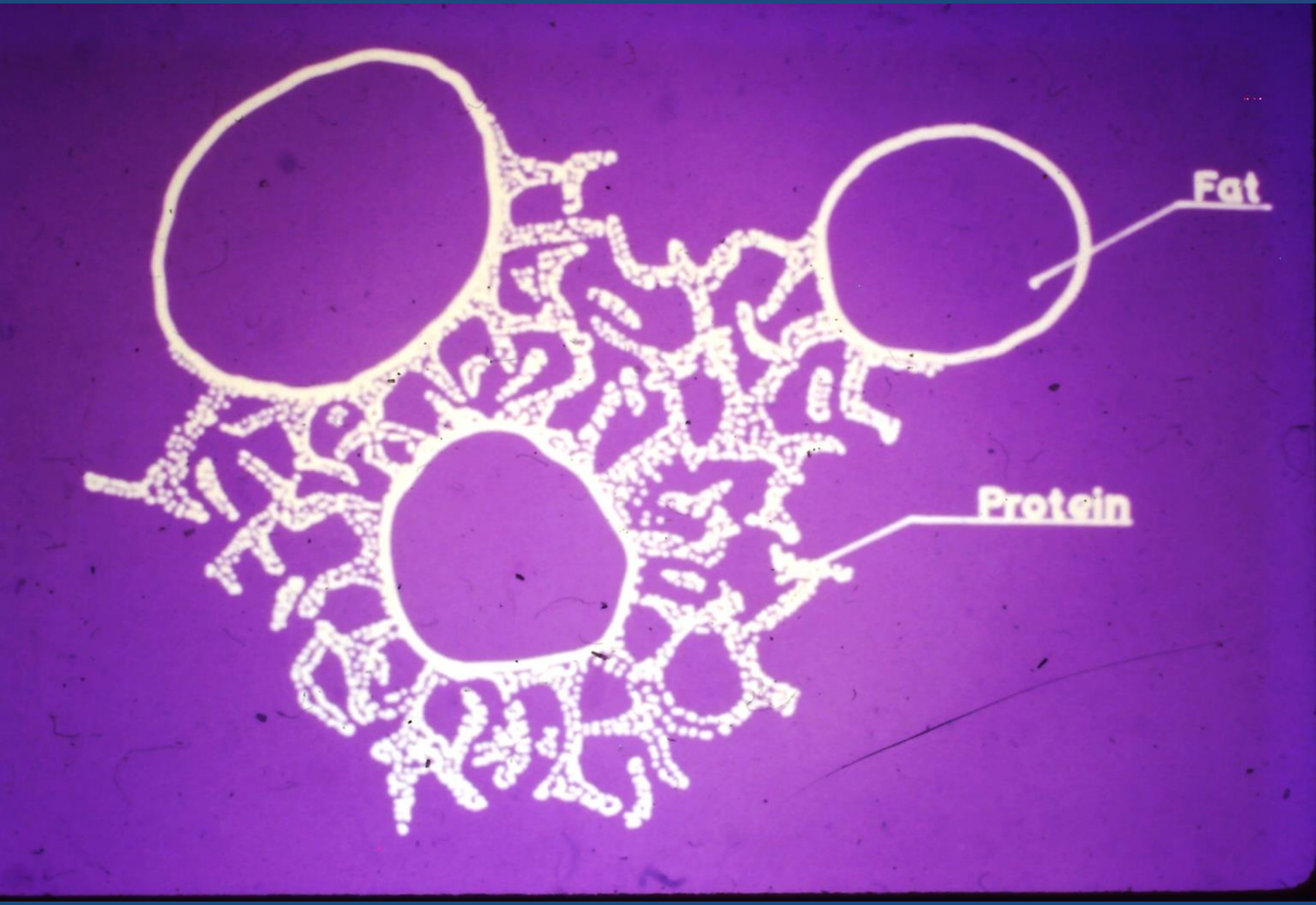
Weak Emulsion



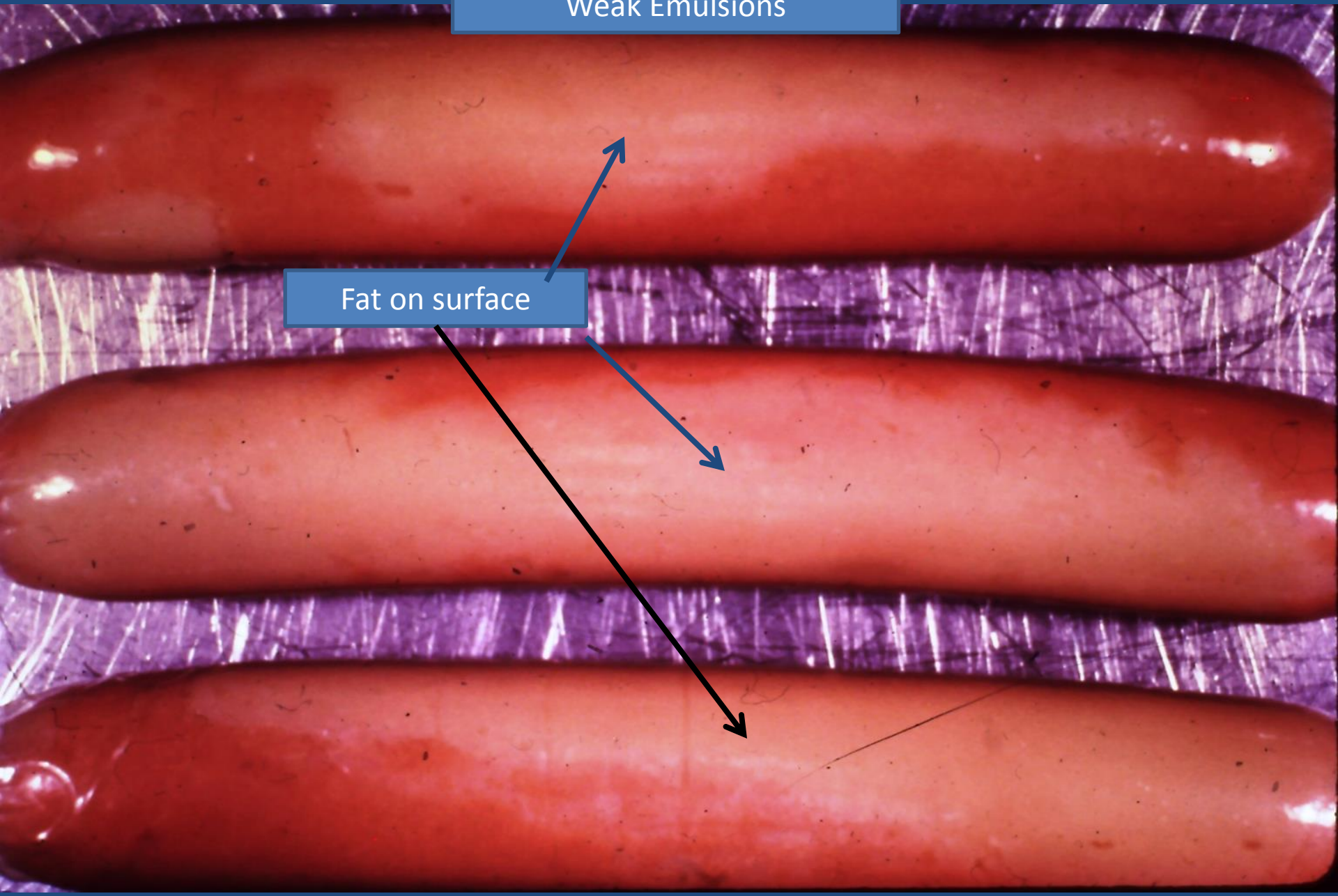
Strong emulsion




Strong emulsion


Fat
Protein

Weak Emulsions



Weak Emulsion – Fat Migrated to Surface

II. MEAT PIGMENTS

A. MYOGLOBIN

- SPECIES
- AGE
- MUSCLE

Myoglobin Derivatives

Oxymyoglobin – O_2 – Fresh Meat Color

Metmyogloben – OH – Oxidized Brown Meat Color

Nitrosohemochrome – NO – Cured Meat Color

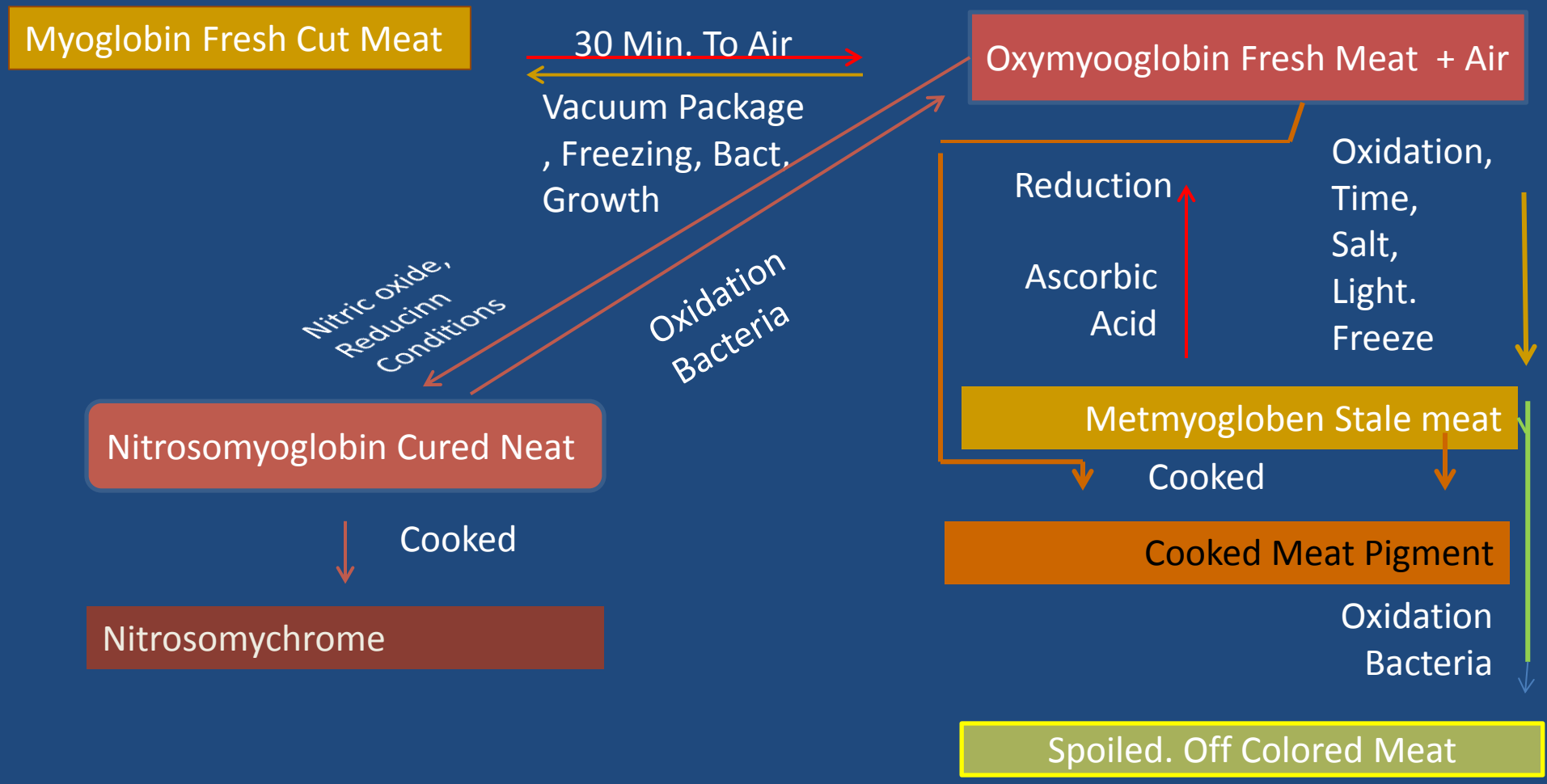
V. MEAT PIGMENTS AND COLOR

MYOGLOBIN STRUCTURE

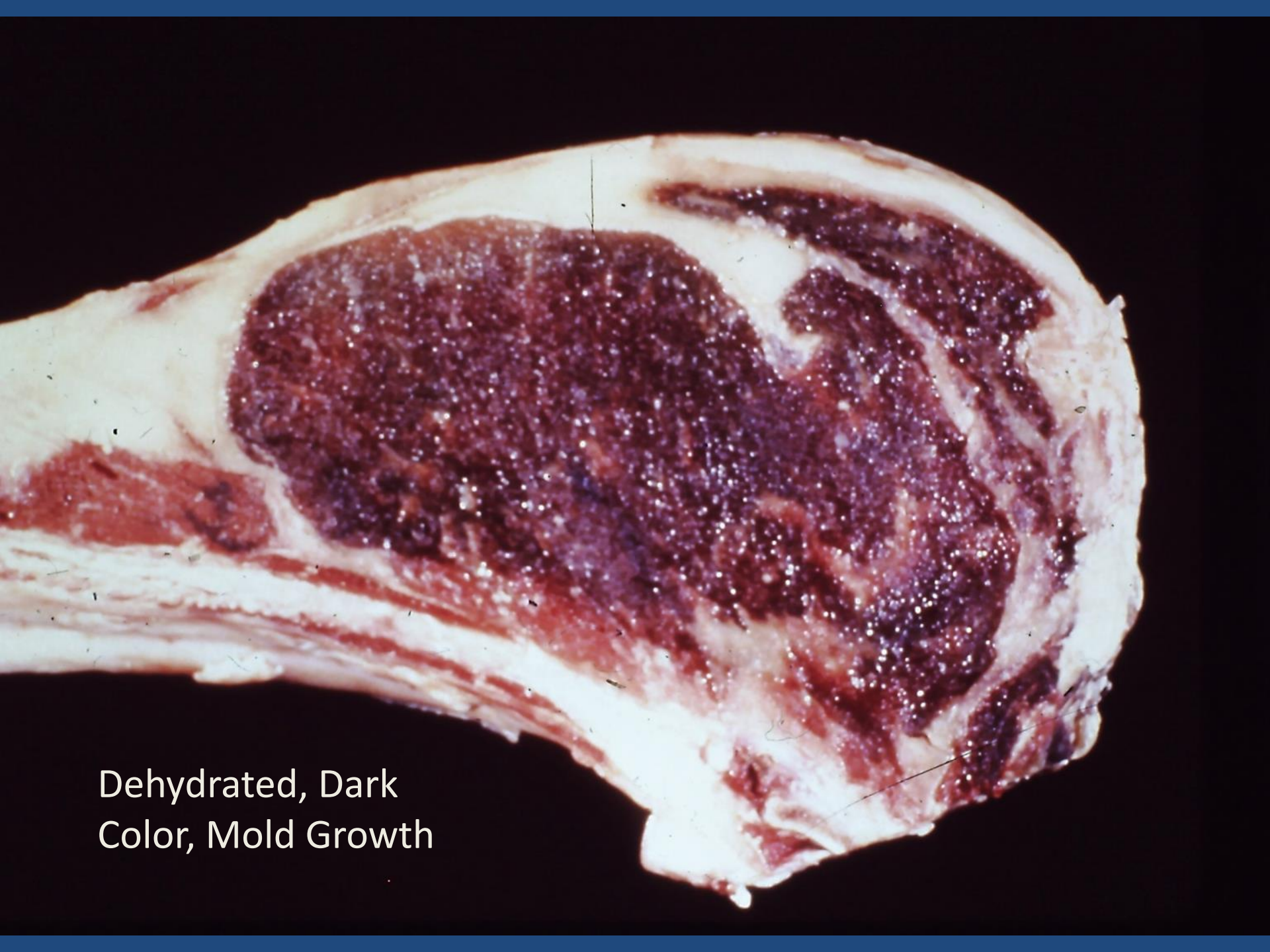
PROTEIN - HEME GROUP

Heat Treatment Smokehouse Temperature and Relative humidity

Drying and Smoking Causes Moisture Movement and Protein Coagulation

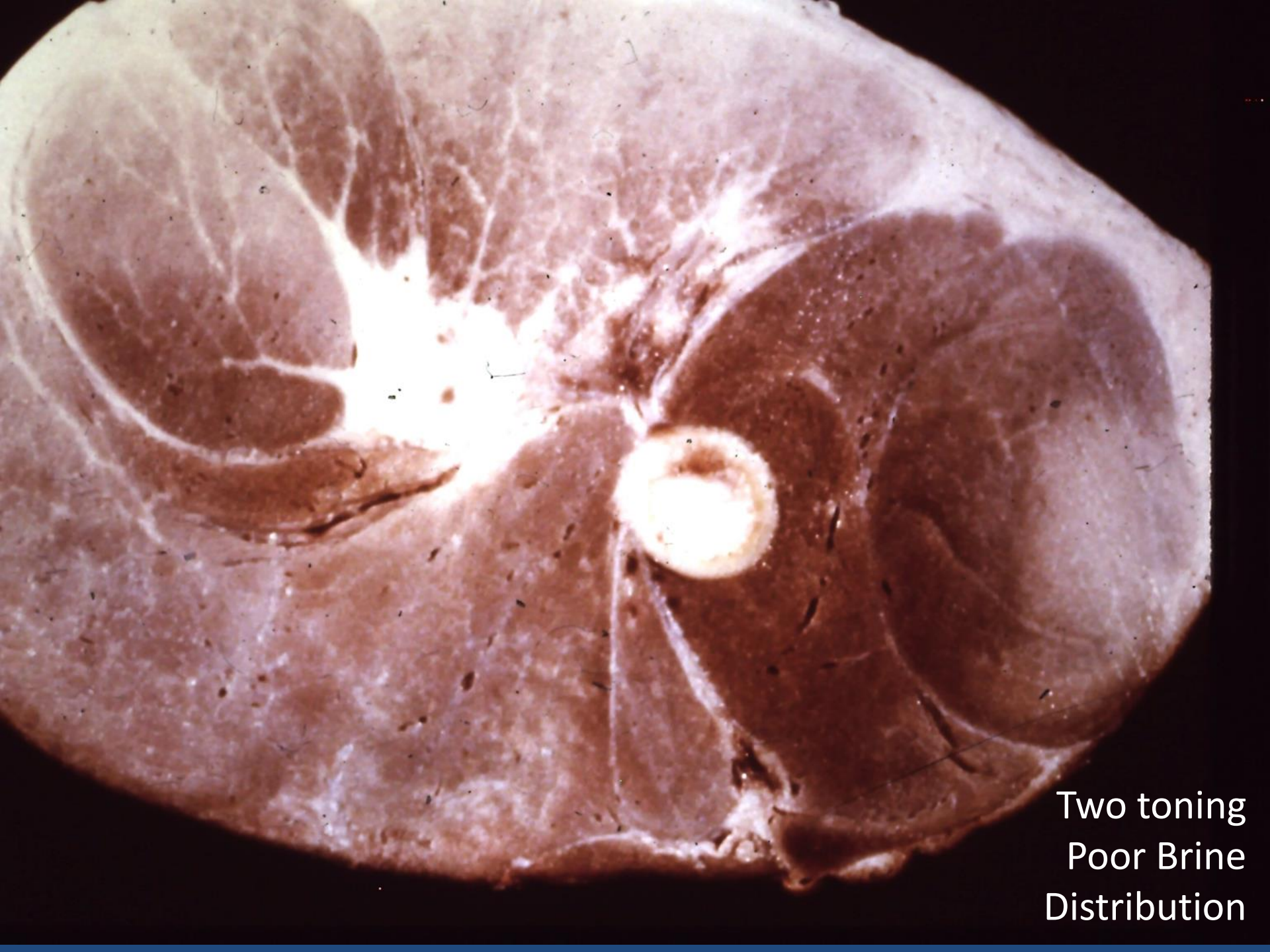

Myoglobin Fresh Cut Meat
30 Min. To Air
Vacuum Package
, Freezing, Bact,
Growth
Oxymyooglobin Fresh Meat + Air
Reduction
Ascorbic
Acid
Oxidation,
Time,
Salt,
Light.
Freeze
Nitric oxide,
Reducinn
Conditions
Oxidation
Bacteria
Metmyogloben Stale meat
Nitrosomyoglobin Cured Neat
Cooked
Cooked
Cooked Meat Pigment
Nitrosomychrome
Oxidation
Bacteria
Spoiled. Off Colored Meat
CURED
UN-CURED


Cross Section
Good Color &
Marbling

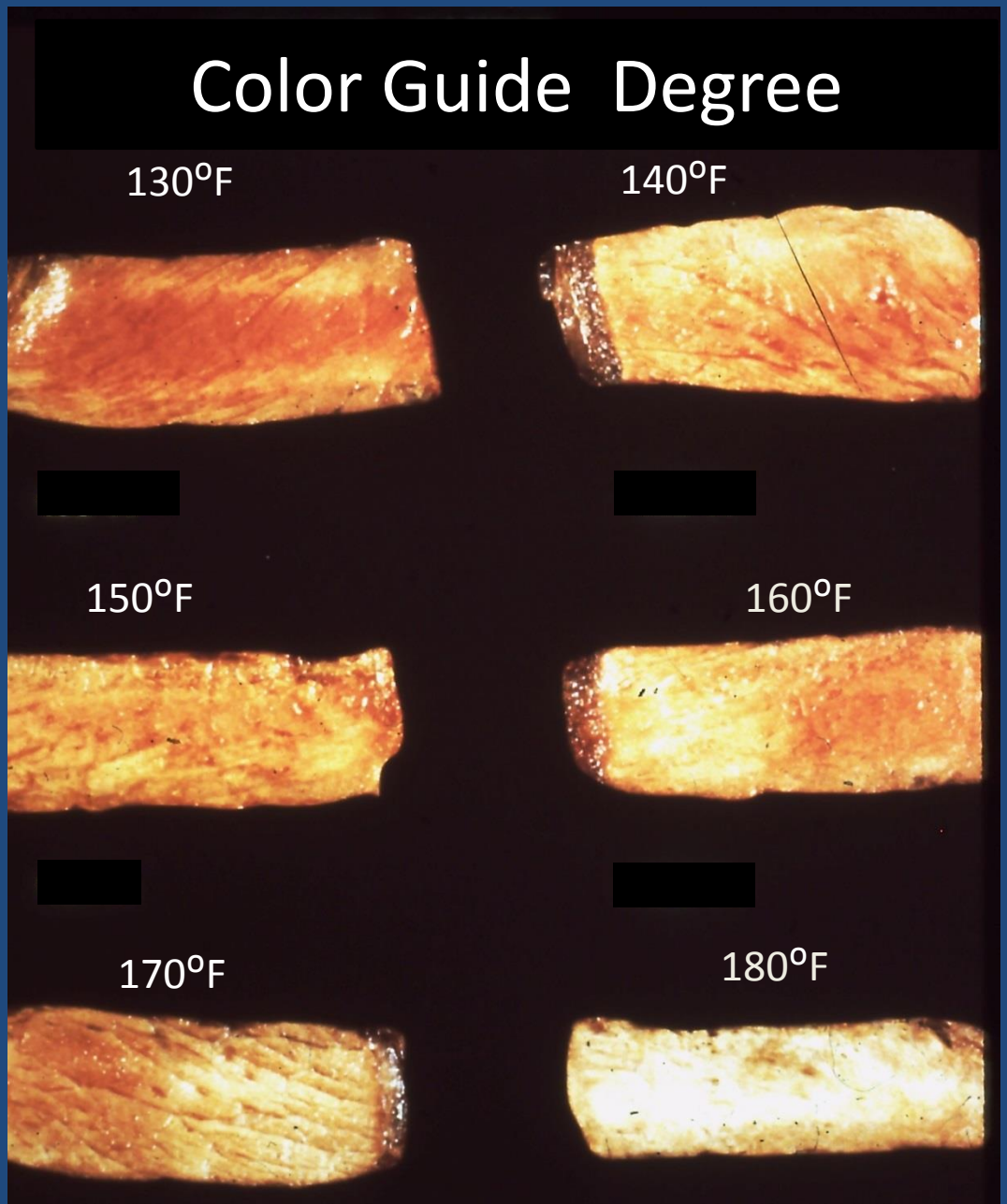

Dehydrated, Dark
Color, Mold Growth


Ham, PSE, Poor
Texture


Ham, Good
Color &
Texture


Two toning
Poor Brine
Distribution


Ham, No
Cure, No
Color


Color Guide Degree
130°F
140°F
150°F
160°F
170°F
180°F

OTHER COMPOUNDS - 1-2%

MINERALS - SALT

CARBOHYDRATES

ORGANIC COMPOUNDS

II. Rigor Mortis

Conversion of Muscle to Meat:

- Muscle Stiffing
- Attempted Shorting

Acid Production:

- pH Drop from 7.0 to 5.6

GLYCOGEN → LACTIC ACID

pH DROPS 7.0 - 5.6

Normal Rigor – Normal pH Decline

A. Pale Soft Exudative (PSE) Pork

Rapid pH Drop to 5.6

B. Dark Cutting Beef

Rapid pH Drop to 6.6

MUSCLE FIBERS

COLD SHORTENING

HOT BONING

ELECTRICAL STIMULATION

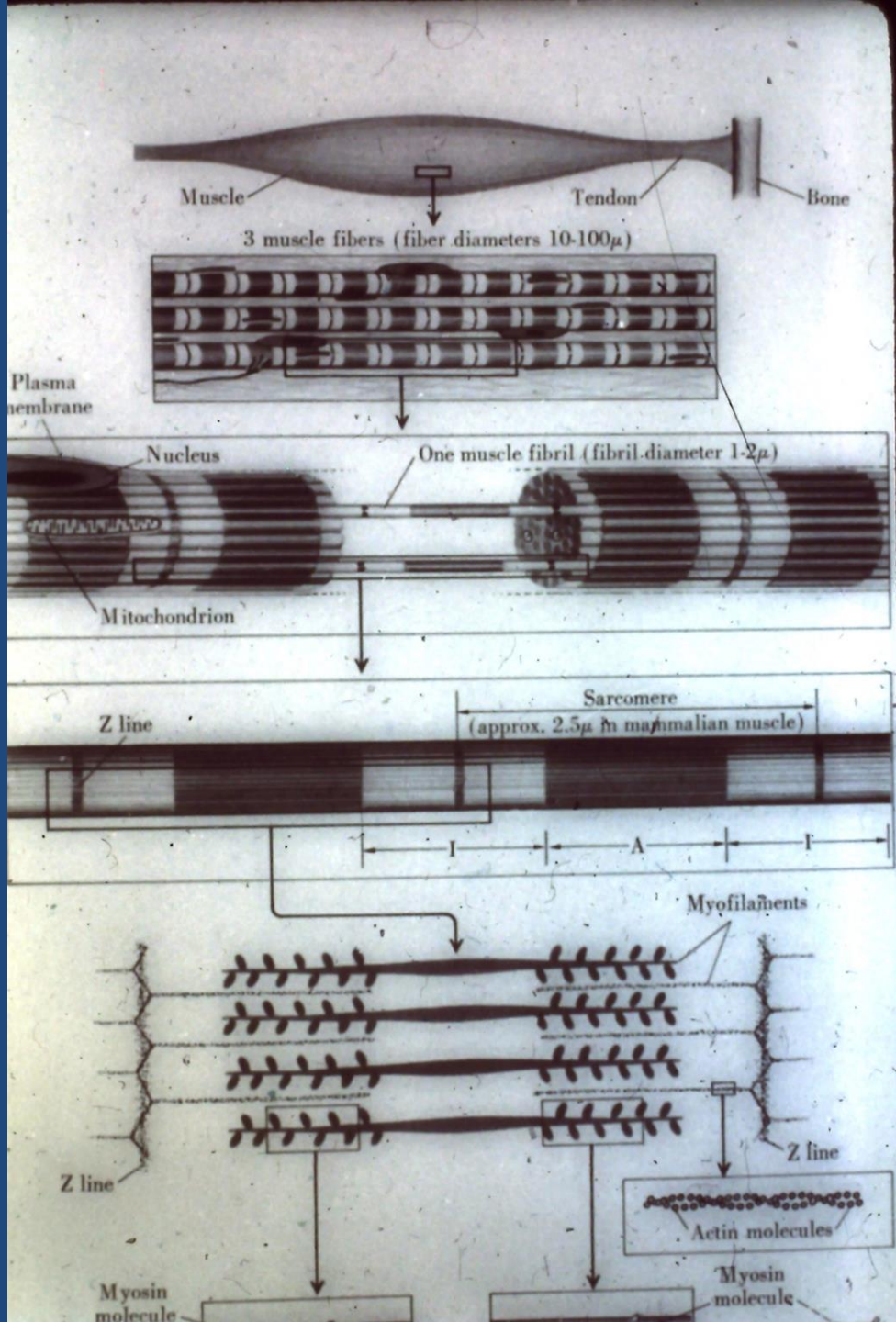
Whole Muscle

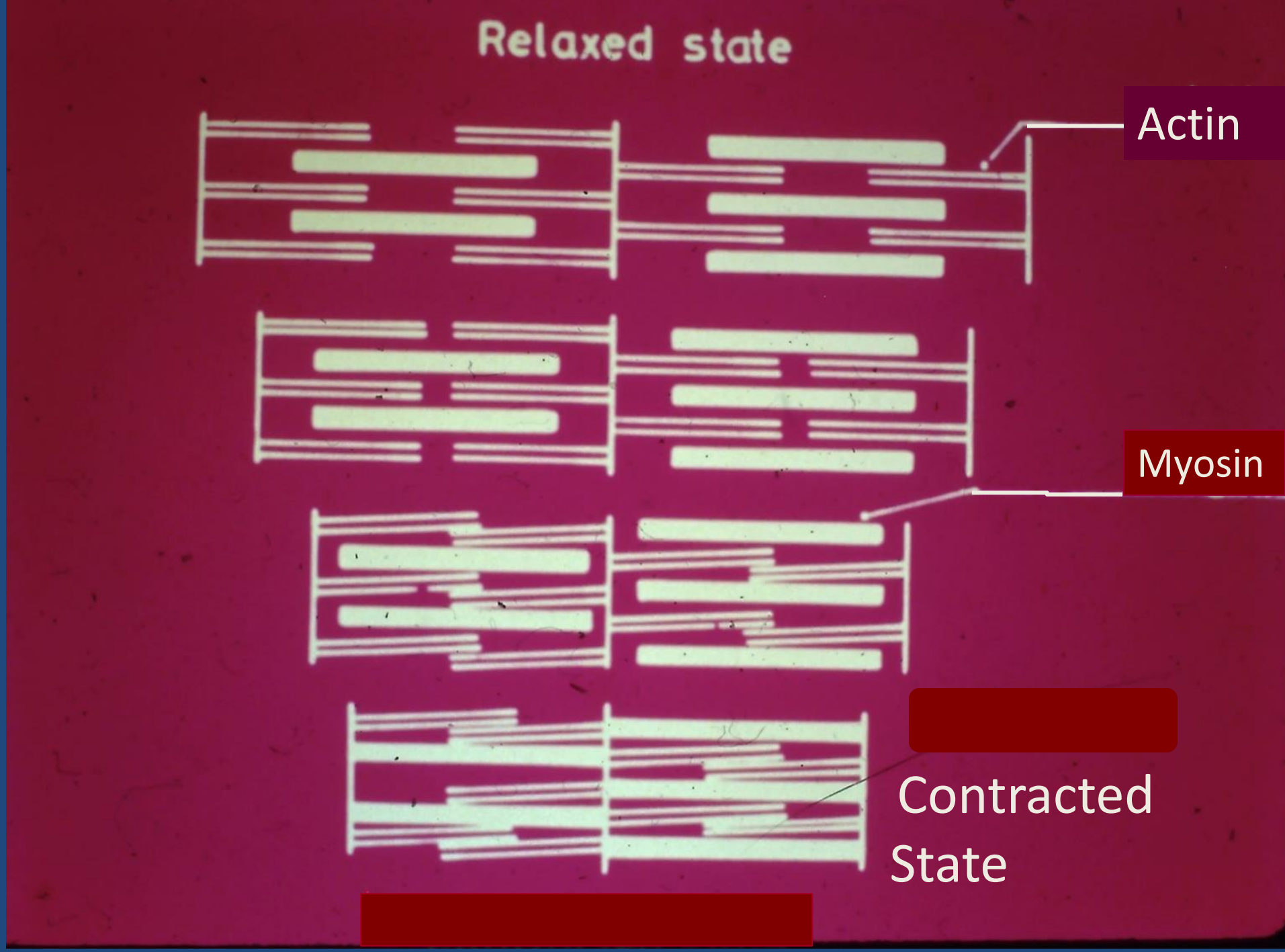
3 Muscle Fibers

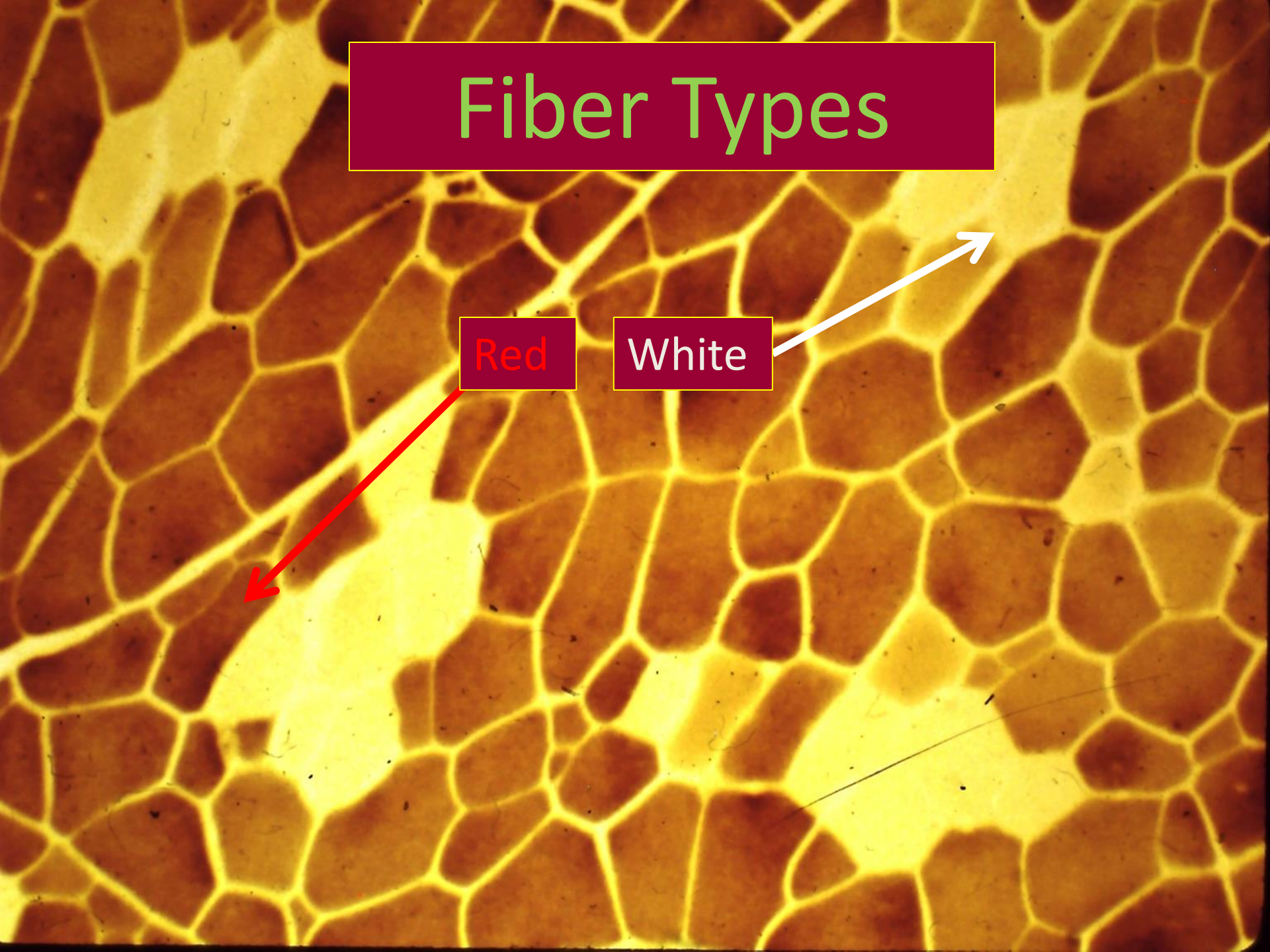
Center – one muscle fiber

Light and Dark Bands

Actin and Myosin Connections between fibers




Relaxed state
Actin
Myosin
Contracted
State


Fiber Types
Red
White

Heat – Cooking

Denatures Protein - Myofibrillar Protein Hardens

Collagen (Moist heat) – Softens – Gelatin

Fat –Renders - Fluid