

MEAT & POULTRY

Food Material Science 2010/11
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MEAT



INTRODUCTION

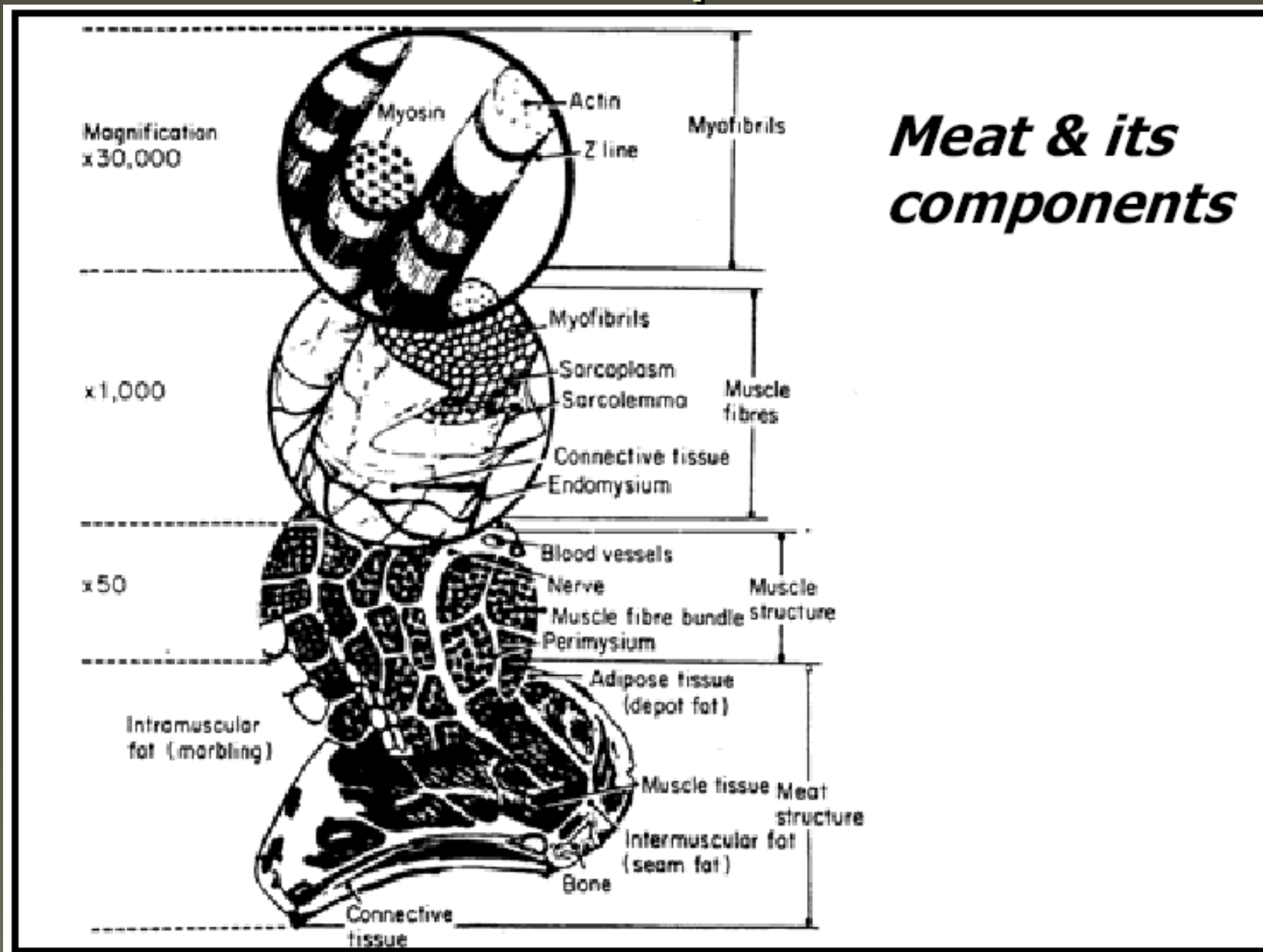
- *'Meat is the post-mortem aspect of the 300 or so anatomically distinct muscles of the body, together with the connective tissue in which the muscle fibres are deposited and such intermuscular fat as cannot be removed without disrupting the muscle as a whole'.*
- *Meat refers to the skeletal muscle from the carcasses of animals – cattle (beef, veal), pork, and lamb (sheep).*

General Composition of Meat

- 20% protein
- 8% fat
- 1-2% glycogen (carbohydrate)
- 1% ash
- 70% water

Species	Composition (%)			
	Water	Protein	Lipid	Ash
Beef	70-73	20-22	4-8	1
Pork	68-70	19-20	9-11	1.4
Lamb	73	20	5-6	1.6

Meat Components



- Muscle fibres are long, multinucleated cells and are also called **myofibres**, or simply fibres.
- Myofibres are typically 40 – 50 μm in diameter and several mm long (1 – 40 mm).
- Each myofibre is enveloped in connective tissue (**endomysium**) and myofibres are arranged longitudinally into bundles which are enveloped in thin sheet connective tissue (**perimysium**).
- Smaller bundle (primary bundles) are grouped into larger bundles, which may be grouped into even larger tertiary bundles.

- Entire muscles are covered by a heavy sheath of connective tissue (**epimysium**). This thickens as it blends into tendon.
- The three of connective tissues (epi-, peri,- and endomysium) are continuum which mainly consist of fibrous proteins – **collagens**.

Parameters of Meat Quality

	Acceptable	Unacceptable
Appearance		
Meat color	Red / pink	Brown, grey green
Fat color	White	Yellow
Texture	Firm	Soft, mushy, dry
Weep	None	Any exudate
Palatability		
Tenderness	Tender	Mushy, tough
Flavor	Typical of sp.	Boar taint, rancid, acid taste
Juiciness	Moist	Lack of flavor

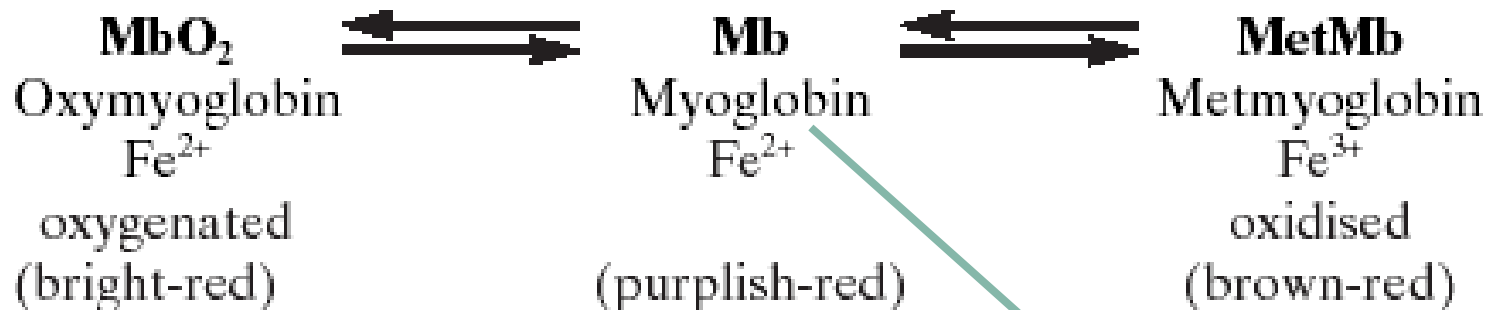
(Laird, 2006)

Meat Color

- Color is often the primary consumer identifier of meat quality and acceptability.
 - Fresh meat to be bright cherry red
 - Cooked meat to be brown/gray colored
 - Cured meat to be pink
- Meat pigments:
 - **Myoglobin** --- the basic pigment of the fresh meat.
 - **Haemoglobin** --- only in small amounts.

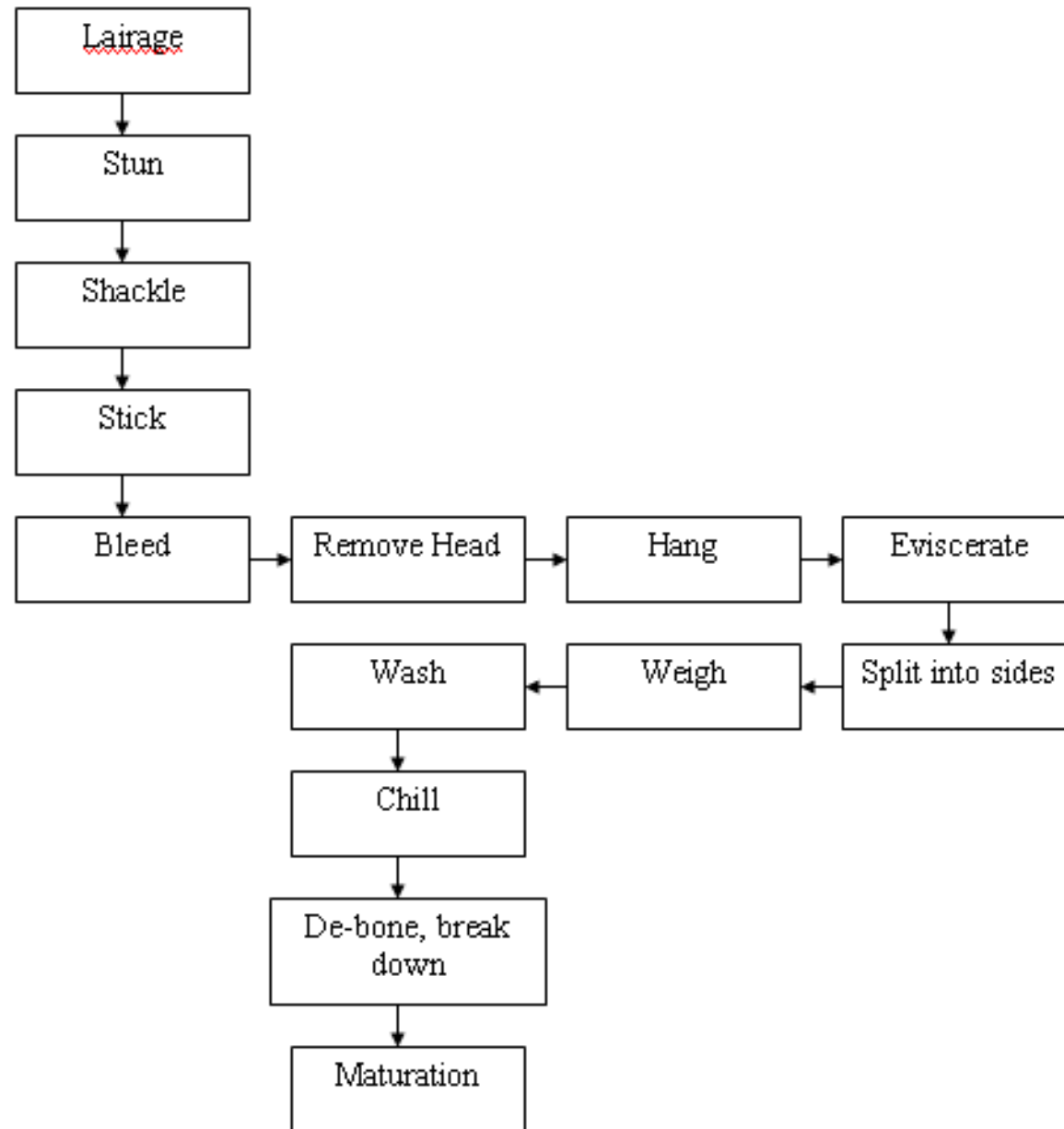
Color of Fresh Meat

- In fresh meat, myoglobin can be found in different forms including:
 - bright-red oxymyoglobin (MbO₂),
 - purple-red deoxymyoglobin (Mb), or
 - brown metmyoglobin (MetMb)



Freshly cut meat

Slaughtering and Dressing of Cattle



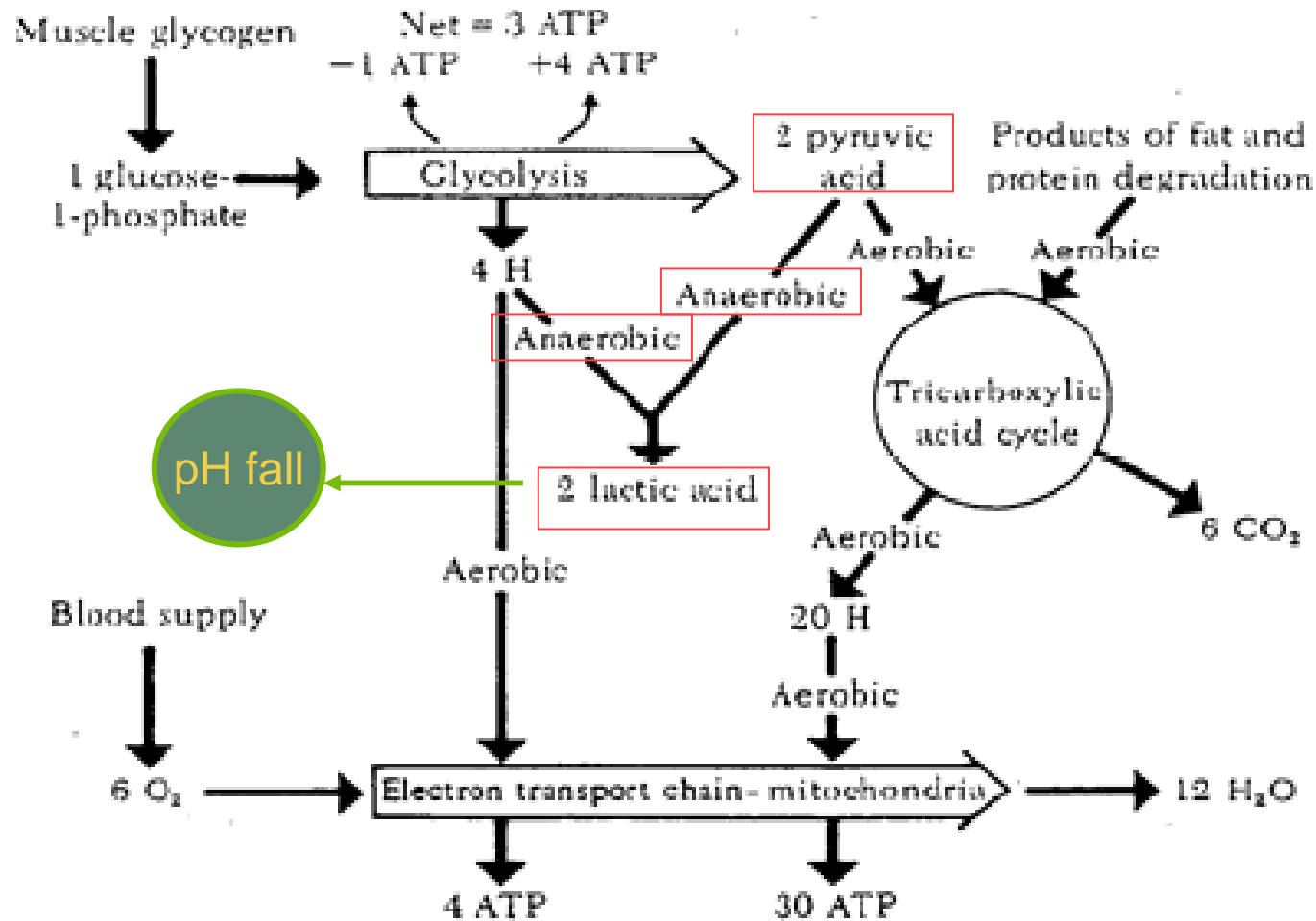
Varnam & Shutterland
(1992)

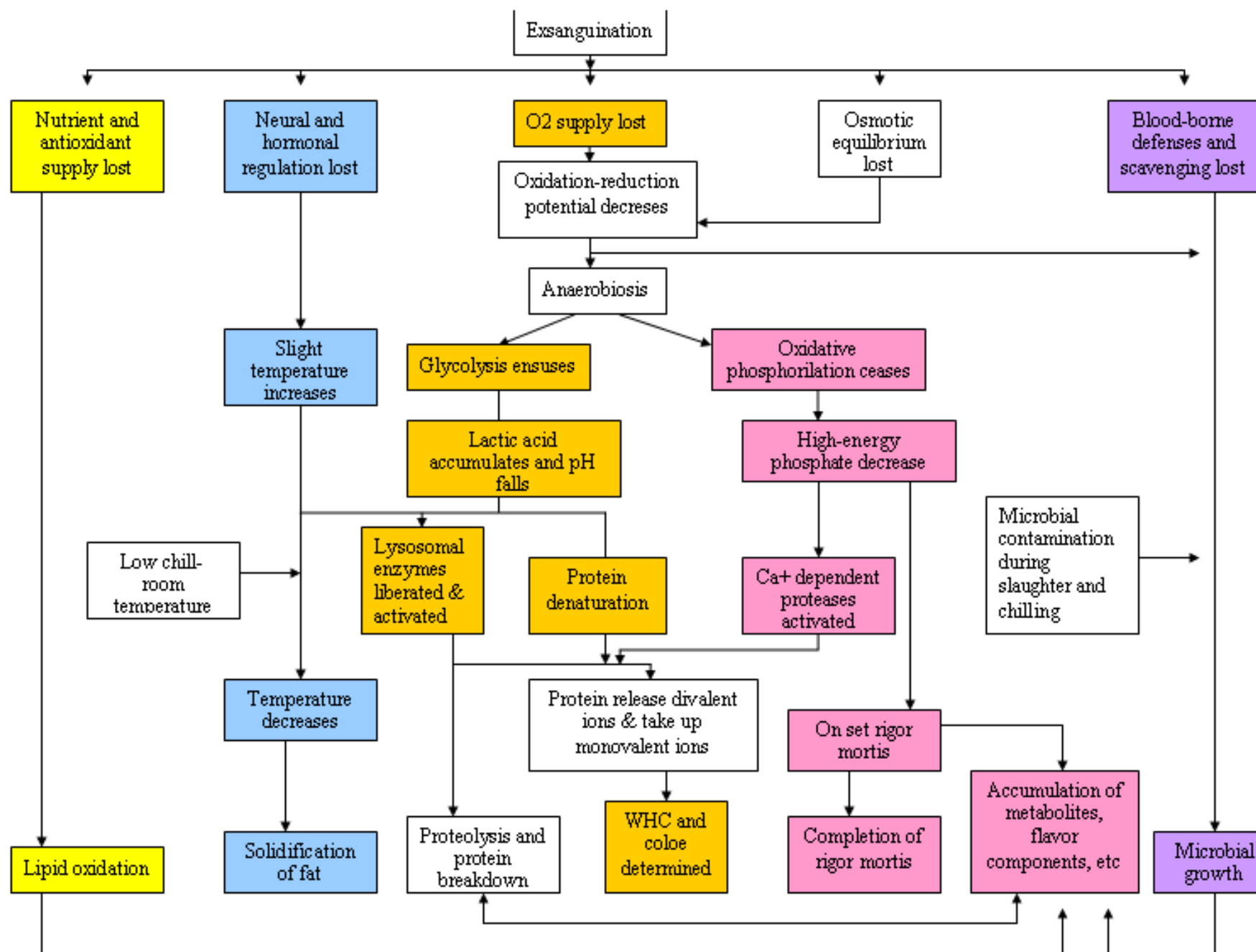
POST MORTEM CHANGES

- Immediately after slaughter, many changes take place in muscle that convert muscle to meat.
- One of the changes is the contraction and stiffening of muscle --- **rigor mortis**.
- Muscle is very tender at the time of slaughter. But when rigor mortis begins, muscle becomes progressively less tender until rigor mortis is complete.

POST MORTEM CHANGES

Energy pathways in muscle





Delay time before on-set rigor mortis

Species	Hours
Beef	6-12
Lamb	6-12
Pork	$\frac{1}{4}$ - 3
Turkey	< 1
Chicken	< $\frac{1}{2}$
Fish	< 1

Ageing

- Holding carcass or meat at refrigeration temperatures for extended periods following initial chilling is called **ageing** or **conditioning**.
- During this period, changes occur that alter the properties of the meat, particularly an increase in its tenderness.
- There are large differences between species in ageing rates:
 - Beef: 14 days
 - Pork: 5 days
 - Chicken: 2 days
 - Lamb: between beef and pork

Differences are due to the differences in rate of proteolysis of the myofibre proteins.

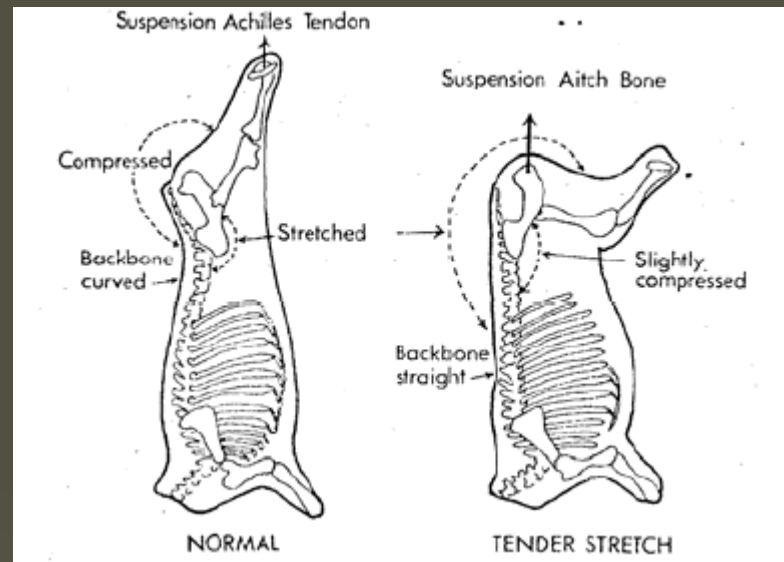
Tenderizing

- Tenderness, juiciness, and flavor are components of meat palatability.
- Tenderness can vary considerably from one cut to another. The differentiation is due to genetics, species, age, feeding, muscle type, slaughtering process (electrical stimulation), chilling rate, ageing, mechanical/ chemical tenderizing, freezing, thawing, and cooking.

Tenderizing Methods

➤ Tenderstretch:

- This method of suspension puts a strain on the muscle fibres and prevents them from shortening to the same extent as normal suspension.



➤ High temperature conditioning:

- Chill for 16-20 hours at 12-18°C followed by normal chilled

➤ Delayed chilling:

- Hold on slaughter floor (20-25°C) for 3-5 hours before placing in chiller

- Cooler ageing:
 - Hold at 0-10°C for 8-72 allow proteolytic enzyme to degrade fibre
- Blade tenderization
- Application of enzymes: papain, bromelin
- Marinading: vinegar
- Produce fat animal for slaughter: fat insulation

Cooking

- Heating cause a toughening of meat fibres due to heat coagulation and shrinkage of the myofibrillar proteins and connective tissues.
- However, prolonged heating can increase the tenderness due to the conversion of collagen to gelatine by heating.
- The physical changes in meat depend on cooking times, temperature conditions and the amount of collagen in meats.


Cooking

- Initial toughening is due to protein denaturation which occurs when the meat reaches 50-80°C.
- This followed by some tenderisation at temperatures greater than 75°C.
- Tenderisation occurs as collagen hydrolyses to gelatine.

POULTRY



INTRODUCTION

- Poultry is the category of domesticated birds kept for meat, eggs and feathers.
 - Examples of types of poultry:
 - Chicken
 - Duck
 - Goose
 - Turkey
 - Quail
 - Pigeons
 - Etc.
- 


Poultry Meat

- Meat from chickens and turkeys provides a high-quality proteins and low fat.
- Fat content is higher in the skin.
- The protein is an excellent source of essential amino acids.
- Poultry meat is also a good sources of phosphorus, iron, chopper, zinc, and vitamins B₁₂ and B₆.
- Poultry meat can be sold as whole carcasses or as cut portions.

Meat Chicken Composition

Species	Composition (%)			
	Water	Protein	Lipid	Ash
Beef	70-73	20-22	4-8	1
Pork	68-70	19-20	9-11	1.4
Chicken	73.7	20-23	4.7	1
Lamb	73	20	5-6	1.6
Cod	81.2	17.6	0.3	1.2
Salmon	64	20-22	13-15	1.3

Processing Steps

- Pre-slaughter inspection
 - Suspension and shackling
 - Stunning
 - Bleeding
 - Scalding to loosen the feathers
 - Picking off the feathers by machine
 - Removing of the pinfeathers
 - Eviscerating (removing the internal organs)
 - Chilling
 - Post-mortem inspection
 - Grading
 - Packaging
- 

- Poultry is slaughtered at an appropriate age to get the eviscerated weight desired by the customer.
- E.g. chickens are slaughtered at 42 - 49 days of age (with average live weight about 4.0-4.8 pounds).

Type	Live Weight (lbs.)	Eviscerated weight (lbs.)
Broiler	4.0 – 6.3	2.8 – 4.4
Roaster	7.4 – 10.0	5.0 – 7.0

Source: Parker (2003)

QUALITY PARAMETERS - COLOR

- Color of cooked / raw poultry meat is important -- - associated with the product's freshness.
- Poultry has white muscles (breast) and dark muscles (thigh and leg).
- Color of meat depends on the presence of myoglobin and haemoglobin.
- Poultry meat color is influenced by bird age, sex, strain, diet, intramuscular fat, moisture content, pre-slaughter conditions and processing variables.

QUALITY PARAMETERS - COLOR

- Discoloration of poultry can be related to:
 - The amount of myoglobin & haemoglobin
 - The chemical states of those pigments
 - The way in which light is reflected off the meat
- The discoloration can occur in an entire muscle or it can be limited in a specific area (e.g. breast muscle).
- Discoloration of meat can occur due to:
 - extreme environmental temperatures
 - Stress due to live handling (pre-slaughter)
 - Bruises

QUALITY PARAMETERS - TENDERNESS

- The tenderness of meat depends upon the rate and the extent of the chemical and physical changes occurring in the muscle as it becomes meat (post mortem changes).
- Meat will become stiffen when rigor mortis is completed.
- Eventually, muscle become soft again/ more tender when cooked.

QUALITY PARAMETERS - TENDERNESS

- Anything that interferes with the formation of rigor mortis will affect meat tenderness, including:
 - Birds struggle before slaughtering.
 - Exposure to environmental stress (hot / cold temperature) before slaughter.
 - High pre-slaughter stunning temperature
 - High scalding temperature
 - Longer scalding times

QUALITY PARAMETERS - TENDERNESS

- Tenderness of boneless/ portioned cuts of poultry is influenced by the time between post-mortem and the deboning.
- Deboning during early post-mortem result in tougher meat since the muscle still have energy available for contraction. When the muscle is removed from the carcass, they contract and become tough --- **ageing is necessary!**
- Electric stimulation can hasten the development of rigor mortis.

QUALITY PARAMETERS - FLAVOR

- Both taste and odor contribute to the flavor of poultry.
- When poultry is cooked, flavor develops from:
 - Sugar and amino acid interactions
 - Lipid oxidation
 - Thiamin degradation
- Age, bird strain, diet, environmental conditions, scalding temperatures, chilling, product packaging and storage can affect the flavor of meat.

Chicken Carcass & Portion Cuts



Whole carcass



Half



Wing



Wing drumette



Winglet



Leg



Thigh



Drumstick



Breast



Trimmed Breast



Stripped Back



Giblet

Thank You...

