

Meat As An Ingredient

■ Myofibrillar Proteins

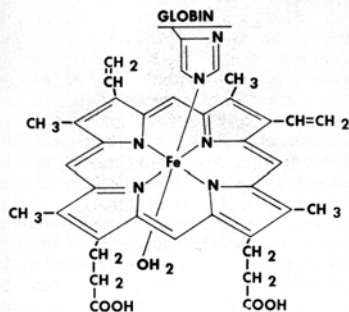
- Myofibrillar proteins are responsible for the contraction ability of living muscle.
- Raw meat materials that are the most expensive generally have the highest level of myofibrillar proteins.
- Much of the processed meat technology is centered on manipulation of the proteins in this group.
- Myofibrillar proteins play an integral role in boneless, and chunked and formed ham or roast beef production.

Meat As An Ingredient

■ Sarcoplasmic proteins

- Water soluble proteins
- In this group, there are hundreds of different proteins, but in small quantities. Most are part of the energy production system.
- Myoglobin is one protein in this group that has significant importance in processed meats.
- Myoglobin gives meat its color. The heme portion of myoglobin has an active site that binds various compounds. The compounds (e.g. oxygen, nitric oxide) bound to myoglobin gives different colors to meat.

Meat As An Ingredient



Meat As An Ingredient

■ Connective tissue proteins

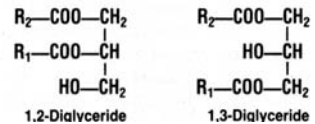
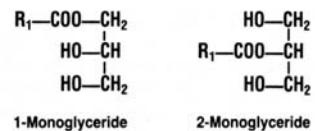
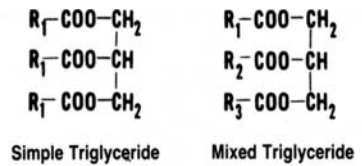
- The connective tissue proteins transmit the movement generated by contraction of the myofibrillar proteins to the skeleton of the body.
- This function requires connective tissue protein to be very tough and strong.
- Collagen is the major connective tissue protein in meat.
- Collagen content varies between different muscles and even within the same muscle.
- If too much connective tissue proteins are present in the processed meat product you could have product failure or at least have a detrimental impact on the finished product texture.

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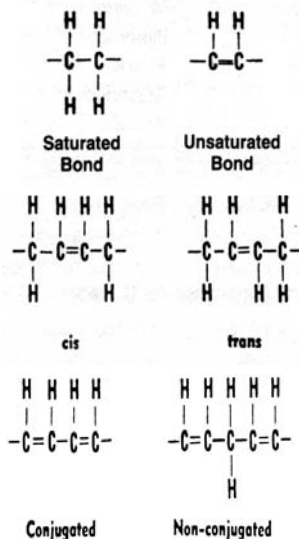
Fat

- Fat the most variable component in processed meat.
- Animal lipids are generally triglycerides, which are glycerol molecules with three fatty acids attached.
- Fatty acids differ due to the differing number of carbon atoms and number of unsaturated bonds in the carbon chain.
- The combination of different carbon lengths and different numbers of unsaturated bonds give fatty acids varying properties, and fat its unique characteristics.
- chain length and amount of unsaturation affects melting point

Triglycerides & Fatty Acids



Fatty Acids



Meat As An Ingredient

- Because pork fat has more unsaturated fatty acids than beef or lamb fat, it is more susceptible to oxidation.
- Fatty acid oxidation occurs at double bonds that eventually break.
- The composite of these off-odors and off-flavors is known as rancidity in raw product and warmed-over-flavor in cooked products.
- The oxidation of fatty acids develops spontaneously.
- This chemical reaction is slowed at low temperatures but not stopped.

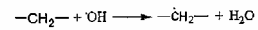
Meat As An Ingredient

- Meat stored in a freezer will turn rancid much more slowly than meat stored in a cooler.
- Metals accelerate rancidity development.
- Sodium from salt also promotes fatty acid oxidation and hence rancidity development.
- Nitrite greatly slows rancidity development.
- Rancidity cannot be masked by mixing a small amount of rancid meat with good meat because the entire product will develop rancidity very rapidly.
- Generally, it is better to discard rancid meat than use it in any quality meat products.

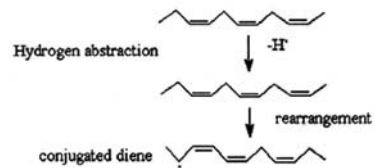
Lipid Oxidation

Three Stages of Lipid Oxidation

- Initiation
- Propagation
- Termination

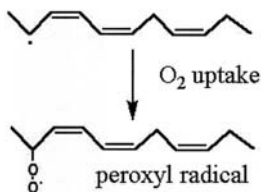


Initiation - extraction of H from unsaturated FA

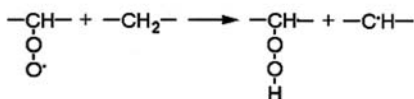


Lipid Oxidation

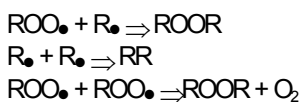
Peroxy radical formation



Propagation



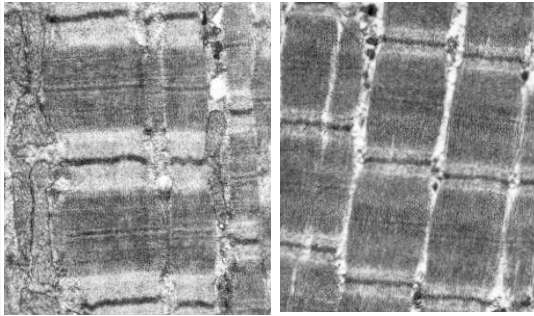
Termination



Meat As An Ingredient

Characteristic	Typical Lean Meat	Range in Meat Products
Water	70%	22-80%
Protein	20%	9-34%
Fat	3%	1.5-34%
Ash	1%	1-12%

Muscle Changes



0 Hours
Postmortem

24 Hours
Postmortem

Postmortem Changes

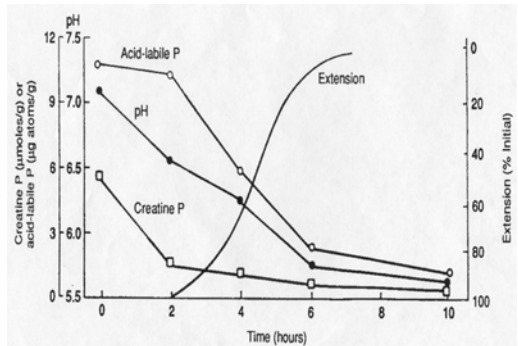
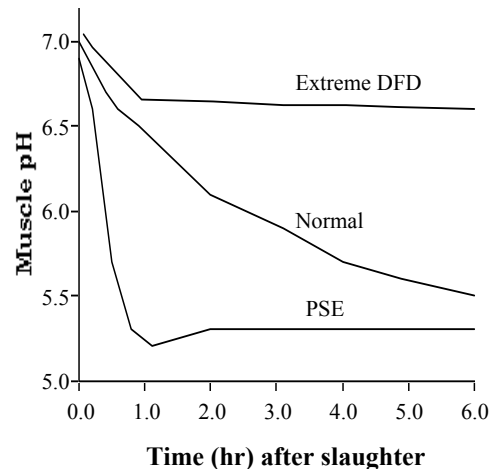


Fig. 1.16. Chemical and physical changes in beef sternomandibularis muscle held at 37°C. Extension changes were recorded on an apparatus similar to that described by Bate-Smith and Bendall (1949) using a load of about 60 g/cm² and a loading-unloading cycle of 8 min on and 8 min off. Zero time: 1 hr 45 min postmortem (Newbold, 1966).

Meat As An Ingredient

- Postmortem pH decline determines meat quality.
- Pale, soft exudative meat results from rapid pH decline PM
- Reduced processing yields, poor bind and sliceability

Meat as an Ingredient



Meat As An Ingredient

- Stress prior to slaughter can result in no pH decline postmortem.
- High pH has dark color but good water-holding capacity
- High pH meat has reduced shelf-life.

Meat As An Ingredient

- Water-holding Capacity (WHC) is one of the most important meat properties to processed products.
- WHC is defined as the ability of meat to retain its water during application of external forces such as heating, cutting, mincing or pressing.
- Many of the physical properties of meat, including color, texture and firmness of raw meat are a result of the water-holding capacity of the meat.

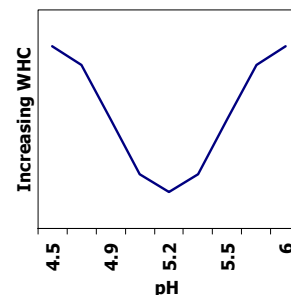
Meat As An Ingredient

- The isoelectric point of proteins is the point wherein the numbers of positive and negative charges are the same or the net charge is zero.
- The isoelectric point of meat occurs at a pH of about 5.4 - 5.6.
- After normal rigor mortis development meat has a pH of about 5.5, and therefore has the lowest WHC possible.

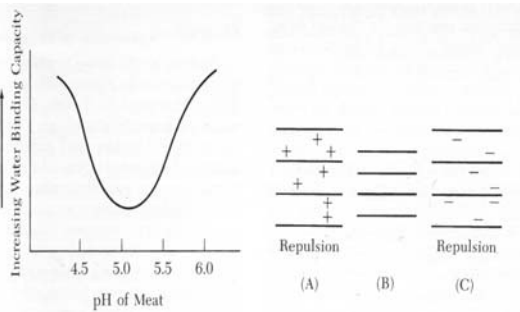
Meat As An Ingredient

- If the pH of meat is raised above 5.4 (an increase in the net negative charge), or reduced below 5.0 the charges repel each other, the protein space increases and WHC increases.

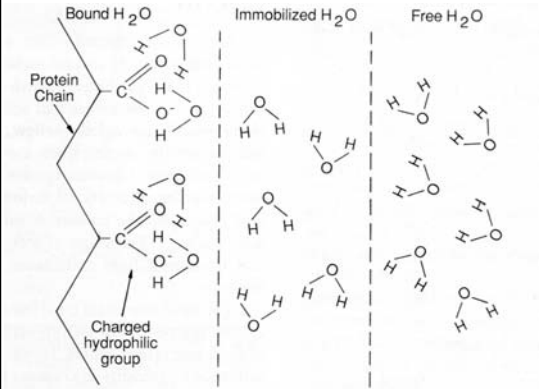
Effect of pH on Water-Holding Capacity



WHC and pH



Types of Water



Meat As An Ingredient

- If the meat pH is increased and the isoelectric point of the proteins is decreased, WHC will be drastically increased.
- Salt addition increases the negative charge on the proteins.
- Salt addition also lowers the protein isoelectric point to about pH 4.5 while it raises the pH of the meat slightly.
- The result of salt addition is a tremendous increase in protein space and WHC.

Non-Meat Ingredients

- Salt
 - most common seasoning used in food products
 - originally used as a preservative
 - modern levels minimal preservative affect
 - salt enhances flavor
 - increases water binding
 - extracts proteins necessary for the manufacture of boneless hams



Non-Meat Ingredients

- Salt Usage Levels
 - 1.5-2.5% in finished product
 - limited by flavor
 - increased levels result in increased yields and bind
 - improves sliceability



Non-Meat Ingredients

- Nitrite and Nitrate
 - used as sodium or potassium salt
 - nitrates only used in dry cure or fermented products
 - used in cured products for color and flavor development
 - also has some preservative action
 - necessary in cured, vacuum packaged products to inhibit *Clostridium botulinum* growth



Non-Meat Ingredients

- Nitrite Usage Levels
 - nitrites are poisonous in high levels so use is highly regulated
 - US Regulations
 - 200 ppm in the finished ham product
 - 120 ppm added to raw belly



Non-Meat Ingredients

- Sodium Erythorbate / Ascorbate
 - used as a cure accelerant in combination with nitrites
 - speeds the reaction of nitrite to nitric oxide
 - shorter processing times
 - lower residual nitrite levels to reduce possibility of nitrosamine formation on cooking
 - residual levels in product improve color stability
- Erythorbate/Ascorbate Usage Levels
 - levels regulated in US
 - 500 ppm

Non-Meat Ingredients

- Phosphates
 - Acid
 - pH modification
 - used in ham and bacon to speed cure development
 - Alkaline
 - increases yield
 - generally increases pH, ionic strength and water holding
 - retards oxidation
 - inhibits cooked flavor deterioration
- Phosphate Usage Levels
 - allowed 0.5% in product
 - flavor limiting near 0.5% added to meat

Non-Meat Ingredients

- Binders and Extenders
 - protein or carbohydrate based binders
 - protein
 - soy
 - milk
 - carbohydrate
 - gums
 - carageenan
 - bread crumb
 - modified food starches

Non-Meat Ingredients

- protein binders can be used in cured pork products
- typical usage is 0.5%- 3.5% depending on protein used
- example of proteins
 - soy protein
 - De-heated mustard flour
 - whey protein
 - plasma protein
 - calcium reduced skim milk powder

Non-Meat Ingredients

- Soy Protein
 - many different products
 - soy flour
 - allowed in sausage at 3.5%
 - soy concentrate
 - allowed in sausages at 3.5%
 - soy isolate
 - allowed in cured pork products at 2%
 - used to increase yield while maintaining product texture
 - soy proteins bind water
 - important to use types meant for injection or brine use

Non-Meat Ingredients

Composition of Soy Protein Products

Item	Protein %	Carbohydrate %
Soy Flour	50	38
Soy Protein Concentrate	70	24
Soy Isolate	90	< 3

Non-Meat Ingredients

Soy Protein Hydration Ratios

Item	Hydration Ratio (water : protein)
Soy Flour	2-2.5 : 1
Soy Protein Concentrate	3-3.5 : 1
Soy Protein Isolate	5 : 1

Non-Meat Ingredients

- Soy Proteins, cont.
 - sufficient moisture to hydrate soy proteins must be in formulation
 - Over-hydration lessens gel strength
 - some powdered products hydrate best with high shear energy
 - to get the most out of soy proteins they must be handled correctly

Non-Meat Ingredients

- Milk Proteins
 - Dried Milk 3
.5%
 - Sodium caseinate 2
%
 - Dried Whey 3
.5%



Non-Meat Ingredients

- Sugar and Sweeteners
 - added mostly for flavor
 - counteracts salt hardening affect and harsh flavor
 - some sugars can cause excessive browning
 - Types used
 - sucrose (common sugar)
 - glucose / dextrose
 - brown sugar
 - fructose
 - honey
 - molasses
 - corn syrup / corn syrup solids



Non-Meat Ingredients

- Gums
 - used to bind water and improve texture and reduce purge
 - carageenan decreases purge and improves sliceability
 - Carageenan (0.5% - 1.5%)
 - Xantham gum and locust bean gum (not to exceed 0.5% in combination with carageenan)



Non-Meat Ingredients

- Starches
 - Food Starch, modified (2%)
 - starches hold water
 - ~ 2 times weight
 - most natural starches need heat to gel
 - some modified ones thicken without heat
 - check with supplier
 - Important in non-traditional processed products



Non-Meat Ingredients

- Flavorings
 - adds variety
 - if using in brine must be soluble
 - ie don't use black pepper in brine unless you want clogged needles
 - Flavor enhancers
 - boost meat flavor
 - hydrolyzed plant protein
 - autolyzed yeast