Lecture 8
Mechanically Separated Meat (MSM)

Utilization of Animal By-products
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Uses of bone

• Edible uses
  – Making soup
  – Making gelatin

• Non-edible uses
  – Bone meal
Needs of mechanically deboned fish (or poultry)

- Deboned meat products needs increase
- Whole carcass utilization
  - Poultry
  - Boxed beef
- Bone removing
  - Traditionally accomplished manually
  - Labor-intensive operations
- How to use these bone?

2009 Class handout
MDM之特性

- 肉質屬於較細緻柔軟的組織，但因其肌肉細胞受破壞，蛋白質變性，脂肪含量高及血色素氧化問題外，且因其易受微生物污染，肌肉纖維顆粒太小，含血液、水分、鐵及鈣離子量較高，易促使快速產生化學或微生物的品質裂變而受限制。

使用狀況

- 早在1940年代，日本人就首先利用機械將魚肉和魚骨分離
- 後來美國應用在家禽類的去骨，增加禽肉加工上副產物和廢棄物之利用，進而促進機械去骨禽肉之發展。
- 現況
  - 目前應用於香腸、火腿等之製造，但使用量有限
Mechanically Separated Meat (MSM)

• Also called “mechanically deboned meat”
• First developed for the fishery industry in Japan in the 1940s, then in the poultry industry
• Approved for use in the red meat industry in 1978
• Labeling regulation in 1982

Surimi

• Processing
  – Mechanically deboned fish (minced muscle) product
  – Washing the muscle with water (or dilute salt water) to remove water soluble components, blood, fat.
  – Removal excess water
  – Mixing with small amounts of sugar and phosphates to protect tissue proteins from denaturation during frozen storage
• Characteristics
  – Higher conc. of salt soluble proteins
  – Better binding ability
  – Bland flavor (so, can used a binding agent without contributing species flavor)
  – To produce simulated shellfish-type foods
Mechanically Separated Meat (MSM)

- a product resulting from the mechanical separation of meat from bone
- Produced by specially designed equipment that crushes the bone and separates bone, cartilage, ligaments, and tendons from soft tissues

- MSM
  - Mechanically deboned fish
  - MD poultry

- red meat
  - Mechanically deboned beef
  - Mechanically deboned pork
  - Mechanically deboned mutton

Materials of MDM

- Irregularly shaped bones of the vertebral column
- Other bones that have meat attached that can be used
- Or whole carcass
• Mechanically deboned poultry (MDP) is to call chicken and turkey (the USDA)

• Mechanically recovered meat – European countries

• Most commonly used for mechanically deboned fish minced fish

How to do

• By forcing bones with meat attached through sieves

• need be ground or broken (1.3~3.0 cm plate) Before being passed against a sieve.

• The products resemble finely chopped meat
Characteristics

- Containing muscle, fat and connective tissue

- Also containing fins, fine bone particle and bone marrow

機械去骨禽肉常應用的產品

- 機械去骨禽肉顆粒細小成乳化狀，適合用來製備乳化產品
- 例如：法蘭克福香腸(frankfurter)、肉羅浮(meat loaf)、波羅納香腸(bologna)、貢丸(meatball)或其他乳化香腸等。
- 去骨肉亦可進一步可以再添加其他成分，調整、加工，作成雞肉香料等
機械去骨骨渣之利用

• 從機械去骨中所得到的骨渣，為一種大量而且價廉的副產物。

• 經適當處理(例如：研磨、磷酸溶解等)，可適量添加少量的骨渣製品在產品中(例如：法蘭克福香腸)，提高蛋白質及礦物質含量。

MDM 利用之優勢

• 降低生產成本，提高此廉價副產物之經濟價值
  - 剩餘的軀殼部位，若以骨肉分離機處理時，可得約 40~50% 以上的機械去骨肉可供利用
• 中大型禽類屠宰廠近年來普遍設立
  - 家禽生產規模增加(由往昔的農村副業進展至目前的企業化生產)
  - 部位肉利用性增加
  - 加工製品增加(vs. 生鮮消費)
  - 原料肉處理後所剩之大量軀殼，因其肉量少，人工取肉不易(且成本過高)
• 減少副產物之環境污染
• 增加製品之功能性
  - 近年來，歐美各國已將MDM有效的利用於乳化肉製品上。
• 開發多元化的雞肉加工品
• 可混合其他原料利用
• 淘汰雞之利用

• 終極目標
  - 為增加機械去骨禽肉之加工利用性，提高這些副產物之經濟附加價值，開發多元化的加工品，以降低生產成本，並藉以解決禽肉工廠對軀殼利用問題。
MDM潜在的問題 (使用上受限制因素):

• 機械去骨禽肉在經擠壓去骨處理時，由於骨髓中所含大量脂肪與原血紅素流入肉漿中，對機械去骨禽肉安定性的影響很大，且原血紅素中所含鐵質會加速催化脂肪自動氧化作用。

• 同時擠壓過程中溫度上升與混入空氣等因子影響，因此機械去骨禽肉很容易氧化酸敗，並造成不良風味與顏色。

MDM潜在的問題 (使用上受限制因素):

• 1. 易氧化酸敗
   - 於去骨過程因空氣混入，脂質容易氧化酸敗。
   - 產品2-硫巴比妥酸（TBA）值快速上升
   - 添加抗氧化劑，能有效抑制油脂游離基連鎖反應，可延緩與降低脂質氧化速度。
   - 考量：真空包裝比一般包裝能有效降低脂質氧化酸敗。

• 2. 顏色：
   - 顏色是一般消費者在購買肉品最重要的考量因素
   - 顏色過深。
MDM潛在的問題 (使用上受限制因素)：

3. 風味

4. 機能特性
   - 添加量考量
   - 適量添加時，可改善產品之組織結著性及保水性
   - 但過量時，反效果。
   - 考量：製品之彈性、咀嚼性、破斷力及硬度等

5. 微生物品質
   - 機械去骨禽肉在去骨過程中，顆粒會變得十分細小，同時溫度上升，使細胞破裂，胞液流出，大幅增加微生物增殖機會。
   - MDM中微生物含量變異影響因子：包括去骨機操作、去骨溫度、骨架來源、儲存時間與溫度等因素。

6. 產品保存期限

綜合言之，建議機械去骨禽肉製作產品後，使用抗氧化劑及真空包裝能降低脂質氧化之情形。
骨肉分離機 (Deboner) 操作

• 基本原理：將帶有赤肉之骨一同絞碎，然後由細孔中，將赤肉以糊狀擠出，而得到分離之機械去骨肉。

• 目前業界最常使用的兩種機械去骨機：
  – (A) 螺旋式機械去骨機
    • 去骨作業方式將帶骨原料肉先經過絞碎處理，再以輸送管輸送至擠壓過篩 (0.3~0.5mm 薩網)，所得到分離之肉漿與骨渣
  – (B) 滾筒式機械去骨機
    • 去骨作業方式將帶骨原料肉先經絞碎處理，再以履帶輸送將肉漿擠壓至滾筒內，分離出骨渣。

Yield

• yields of MSM, MDP and minced fish are equal to these obtained by carefully scraping all visible muscle from the bones to be mechanically separated.

• Depending on the parts of bone
  – 21-27%: ham or picnic bones
  – 48-63%: beef neck and veal back bones
  – MDP: 55-70%
Calcium problem

- USDA (1982) stated that the maximum allowed calcium content of 0.75%
- Bone residue

Lipid composition

- Partially is from bone marrow (16~30%)
- Red marrow in vertebrae and round bones increases with age
- influence the fatty acid content
Marrow problem

- The color-dark red
- The pH-high
- iron content

Bone particle and residue

- The bone content of MDP is limited to 1% (USDA, 1969)
- The calcium content of MSM is limited to 0.75% (USDA, 1982), which is the equivalent of 3~4% bone. (depending on age)
The usage of MSM and MDP in USA

• MSM is limited to 20% of the meat ingredient in a product and no more than 0.6~0.8% bone is allowed in products.

• No usage limit for MDP, so products containing MDP can contain 1% bone

Bone particle size

• Bone particle size are usually largest in minced fish, intermediate in MDP and smallest in MSM.

• A bone particle of <850um in MSM (USDA)

• 98% of the bone particles must be less than 0.84mm and 100% must be less than 2.0mm.-Candaian.

• no bone particle size is specified for MDP and minced fish US regulation
Advantages

- Cost
  - Labor
  - materials
- Nutritional value
- Water holding capacity
- Emulsion properties
- Cooking Loss
- Color

Costs

- Reducing processing costs and consumer prices

- In general, the price of MSM, MDP and minced fish is about 20~30% of that of the hand boned meat
Nutritional values

- Calcium-bone particle
- Iron-marrow
- Cholesterol-marrow
- Protein quality

Emulsion properties

- Better emulsion stability and emulsifying capacity. (10-20%)
- The amount of red marrow-high in albumin and hemoglobin.
- A superior binding strength
Cooking loss

- The cooking loss of products containing MSM, MDP and minced fish are well documented.

- Slightly lower cooking loss during heating when bologna sausage made with MSM was compared with that made with hand boned meat.

- The cooking yield of turkey loaves improved.

- The cooking loss of most products are not changed when lower levels 10-20% are added.

Color

- Marrow contributes to the bright red color of MSM. But oxidation of pigment is a problem.

- In raw meat or processed meat is desirable.

- In restructured breast or steak or white sausage are problems.

- The ratio of muscle to red marrow in MSM can cause color variation. (for different batches)

- To overcome problems, rapid freezing immediately after deboning.
Water holding capacity

• An improvement in holding capacity of finely chopped, ground or chrunked and formed meat products containing MSM, MDP or minced fish.

• Cause:
  – high pH-6.8-7.4 (marrow)
  – high Ca$^{+2}$ and Mg$^{+2}$
  – higher connective tissue

Limitations of MDM

• image
• Microbiological properties
• Oxidative stability (oxidative rancidity)
  – Incorporating heme iron from bone marrow and O2 into products
• Sensory characteristics
Images

- not having a good public image
- Bone chips
- Toxic substance
- Lower value

Microbiological qualities

- Prerequisite
  - Raw material quality
  - Sanitary handling
    - Low temp and limited storage

- USDA recommendation

- Pathogens
- Contamination
Oxidative stability

- Unsaturated fat from marrow
- Fine grinding
- Incorporation of air
- Contacted with metal
- Temperature

Sensory characteristics

- Difference in flavor between products made with hand-boned meat and MSM or MDP.
- Rancidity
- Softer
- A grainy or gritty texture
- 20%
Protein Quality

• Protein efficiency rations (PER), a PER value of 2.8 for casein

• USDA(1982) regulation for MSN have always included a minimum PER of 205 or an essential amino acid content of at least 33% of the total amino acid present.

• Hand deboned beef and pork : 35-40%
• Lamb neck bone : 35-39%
• Beef neck bone : 32-39%
• Beef rib : 34-36%

• Questions protein quality
• Have large amount of connective tissue (20-30%)
• Low in the essential amino acid and has low PER.