IMPROVING HEALTHIER MEAT PRODUCTS

Prof. Dr. Meltem Serdaroglu
Ege University Food Engineering Department
Izmir

Meat and meat products are a food category with both positive and negative nutritional properties.

Major sources for bioactive compounds;

- Iron
- Zinc
- Conjugated linoleic acid (mainly ruminants)
- B vitamins (Jimenez-Colmenero et al.,
- 2001).

They are also associated with nutrients and nutritional profiles that are often considered negative;

- High levels of saturated fatty acids
- Cholesterol
- Sodium
- High fat
- High caloric content

- **Fat has more than twice the calorific value of protein and carbohydrates.**

World Health Organization

- **Fat should provide between 15 and 30% of the calories in the diet.**
- **Saturated fat should not provide more than 10% of these calories.**
- **Cholesterol intake should be limited to 300 mg/day (WHO, 1986).**

Minimising negative nutrients and improving nutritional profile

- Modification of carcass composition
- Manupulation of raw material
- Reformuation of meat products

Modification of Raw Meat Material

- **Genetic selection**
- **Nutrition and feeding management**
- **Growth-promoting and nutrient partitioning agents**
- **Immunisation of animals against target circulation hormones**
- **Releasing factors and gene manipulation techniques are the main attempts**
- **(Byers et al., 1993; Hay and Preston, 1994).**

- **Dietary supplementation of fat and oils is an efficient method to modificate the fatty acid composition of meat.**

- **According to the joint statements by the WHO and FAO the recommended ratio of polyunsaturated fatty acids and saturated fatty acids in diets should be between 0.4 and 1.0 while ω-6/ω-3 PUFA ratio should be between 1 and 4 recpectively.**

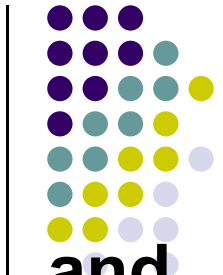
- **All forms of ω3 fatty acid content significantly increased by feeding diets supplemented with fish oil for 38 days in broiler chickens (Grashorn (2001).**

- **Dietary supplementation with vegetable oils including linseed oil and rapeseed oil could also increase ω3 fatty acid content in the form of linolenic acid, which could be used to synthesize long chain ω3 PUFA (Lopez-Ferrer et al., 2001).**

- These practices are limited by the fact that increasing levels of unsaturated fatty acids decreases the oxidative stability of the meat product. Antioxidant technologies must also be employed to minimize oxidative deterioration.

- Alteration of dietary fatty acids to change muscle composition is most easily accomplished with oleic acid since it is at least 10 times more stable than polyunsaturated fatty acids such as linolenic (McClements & Decker, 2008).

Manupulation of raw materials



- Extensive trimming to remove external and internal fat from the carcass.
- Further trimming on primal cuts
- The lipid content in edible lean meat today is less than 5% (Chizzolini et al., 1999).

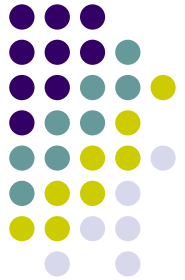
Product Desing

- Nutritional
- Technological
- Sensory
- Safety
- Legality
- Cost

Technologic factors

Product type
Process type
Final composition

Reformulation of meat products



- Reduction of fat content.
- Modification of the fatty acid profile.
- Reduction of cholesterol.
- Reduction of calories.
- Reduction of sodium content.
- Reduction of nitrites.
- Incorporation of functional ingredients.

Fat redeuction process based on selection of lean material, increasing water content and the addition of non-meat additives such as carbohydtares and proteins.

Fat effects;

Tenderness
Flavour
Juiciness

Reducing fat resulted;

Rubbery, dry texture
Lack of flavour
Low WHC

Increasıng Water Content

Adding water to lean meat creates a low-fat formulation. As the fat content falls and the water content rises improves sensory and texture characteristics of the products.

However increasing the water content beyond traditional levels results;

- Lower stability of the meat system
- Excess purge
- High cooking loss
- Soft texture
- Freeze/thaw instability
- Purge in the refrigerator

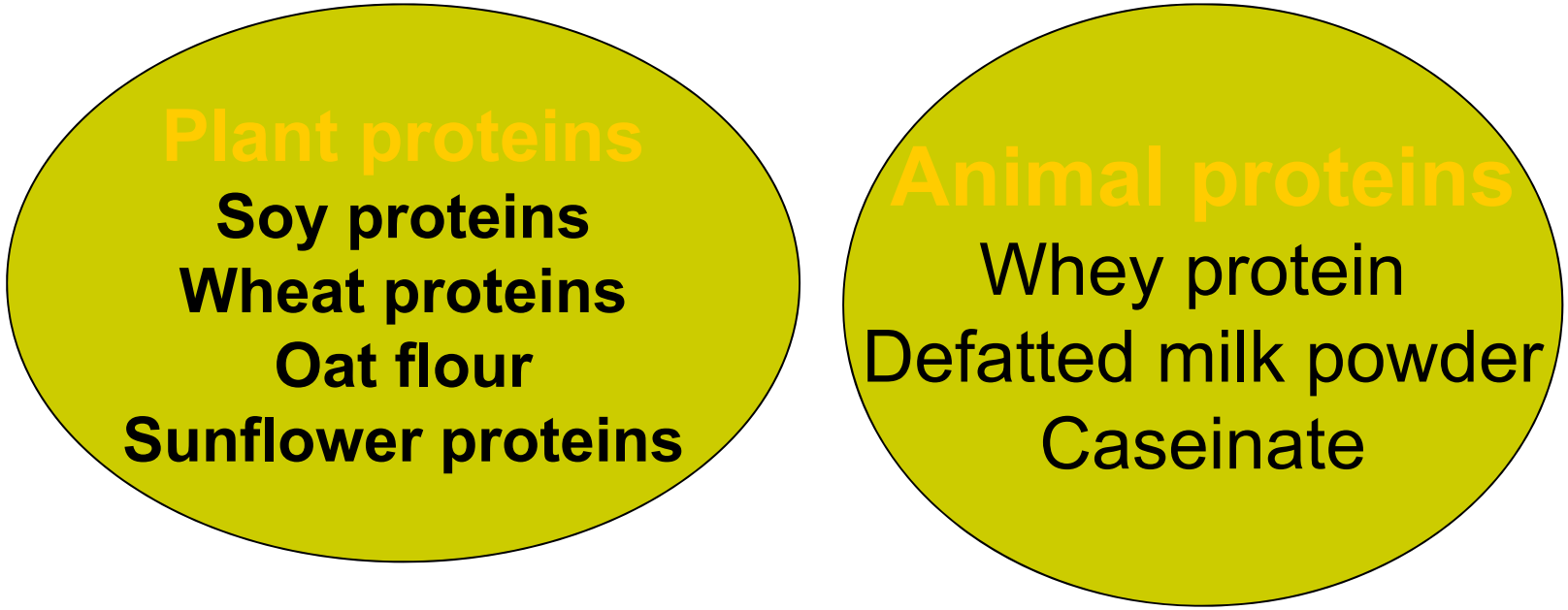
Adding water

Water can be structured in different ways:

- **Increasing the meat content**
- **Plant and animal proteins**
- **Hydrocolloids**
- **Dietary fiber**

Protein based additives

- **One important property of non-meat additive is the ability to bind water**



Plant proteins

- Soy proteins are typical of such proteins with health-enhancing activity. They are thought to be effective for preventing cardiovascular diseases, cancer and osteoporosis.

Functions in meat products

- Improve water and fat binding ability
- Enhance emulsion stability
- Improve nutritional content
- Increase yields

- Soy flour
- Soy protein concentrate
- Isolate

(Chin et al., 2000).

- Wheat proteins could be a great additive due to their ability to form viscoelastic mass of gluten through the interaction with water.

- Addition of 5% wheat protein increased water holding capacity and decreased cooking loss (Serdaoglu and Ozsümer, 2003)

Dairy Ingredients

- Dairy ingredients have been used as fillers and binders in comminuted meat products to improve texture and sensory properties and minimize cooking losses (Serdaroglu,2006). They form gels upon heating and cooling, increasing the firmness of sausage type products.

- **In frankfurter type sausages whey proteins** ;
- Improved emulsion stability
- Provided better color properties
- Resulted in lower chewiness and elasticity

(Serdaroglu and Özsümer, 2003; Serdaroglu and Deniz, 2004).

- **The addition of whey powder 2% or 4% did not significantly alter sensory properties and improved cooking characteristics of low fat meatballs (Serdaroğlu, 2006).**

- **Milk powder and sodium caseinate in low fat turkey rolls increased cooking yield and improved sensory properties (Serdaroğlu and Deniz, 2003).**

Dietary fibre

- Dietary fiber is defined as the remnant of edible part of plants and analogous carbohydrates that are resistant to digestion and absorption in human small intestine (Prosky, 1999).

- Increased intake of dietary fibers has been recommended due to their effects in reducing the risk of colon cancer, diabetes, obesity and cardiovascular diseases (Eastwood, 1992).

- Dietary fiber is one of the ingredients to provide meat products with low-fat and high fibers.

- **Fiber fortification into sausages at nutritionally significant levels (2–3 g/serving) can be accomplished without adverse effect on sensory quality (Choi et al., 2008; Salazar et al., 2009; Yilmaz & Gecgel, 2009).**

- **High water binding and significant water retention ability of fibers can help decrease cooking losses or purge in vacuum packages of meat products.**

- **The source of fiber is also important because different plant structures can affect fiber properties.**

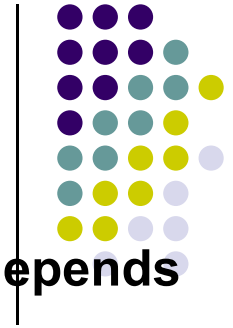
Hydrocolloids

- Hydrocolloids are high hydrophilic substances that can retain up to 100-500 times their own weigth of water (Morris, 1973)
- Alginate
- Carragenan
- Xantangum
- Cellulose derivatives
- Starches
- Pectins

Modification of fatty acid profile

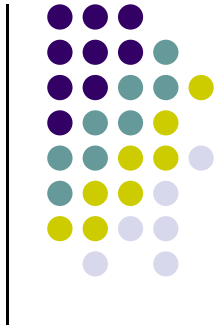
- The second procedure consist of replacing part of the animal fat in the product with another source that less saturated fatty acids and more monounsaturated or polyunsaturated acids and with no cholesterol.
- Depending on the kind of oil, products may present different sensory properties than the reference one (Yıldız-Turp and Serdaroğlu, 2010).
- Olive, palm, soy,corn, sunflower, peanut oils have been used for this purpose.

Reduction of Cholesterol and Calories

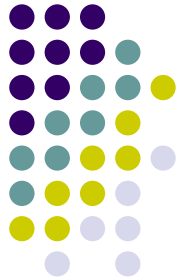


- **The amount of cholesterol in meat and meat products depends on various factors, in general it is less than 75 mg/100g.**
- **Reducing the percentage of fat in the product did not seem to be a viable method for lowering cholesterol. Dietary cholesterol is strictly linked to animal cells.**
- **Lowering cholesterol could be obtained by replacing fat and lean meat with other materials that containing no cholesterol.**
- Simple fat replacing does not reduce caloric content however fat reduction helps limit the calorie content of the meat product. In meat derivatives containing only 6% fat, as much as 50 % of the calories come from fatty material.

Reduction of salt



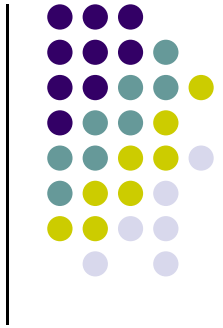
- Most processed meat products contain variable amounts of salt and are associated with high salt contents.
- Meat industry and consumers have become more aware of the relationship between sodium and hypertension, in many countries, the demand for low salt meat products has increased.
- A particular problem with low salt meat products is that only the perceived saltiness, but also the intensity of the characteristic flavor decreases, when salt is reduced.
- Solubilization of muscle proteins in salt solutions is an important physicochemical process in the manufacture of processed meats.



- Replacing KCl
- Sodium citrate
- Change the partical size of NaCl crystals

Much work still needs to be done

Potential functional ingredients;



Conjugated linoleic acid (CLA)

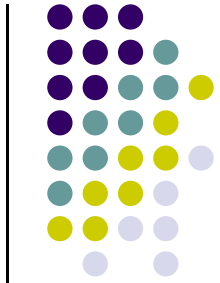
- Conjugated linoleic acid (CLA) which was initially identified in extracts of grilled beef. Beef fat contains 3 to 8 mg /g CLA. (Schmidt et al., 2006).
- It is composed of a group of positional and geometric isomers of octadecadienoic acid (18:2). The most common CLA isomer found in beef is cis-9 and trans 11.
- Rumen bacteria convert linoleic acid to CLA by their isomerase, it is more abundant in ruminant animals.
- Anticarsinogenic activity
- Antioxidative
- CLA content of meat incresed with a supplementation of the animal feed by linoleic acid.
- CLA also plays a role to control obesity.
- CLA has shown to be able to decrease the accumulation of cholesterol.

Meat protein-derived bioactive peptides

- Meat protein-derived peptides are another group of promising functional components of meat (Arihara, 2006).
- Although the activities of these peptides in the sequences of proteins are latent, they are released by proteolytic enzymes (i.e., muscle, microbial, and digestive proteinases).
- Therefore, meat proteins have possible bioactivities beyond a nutritional source of amino acids alone.
- Both carnosine and anserine, are antioxidative peptides and also heve been reported prevention of diseases and aging related to antioxidative stress.

(Park et al., 2005).

- – Antihypertensive (ACE inhibitory);
- – Antioxidative;
- – Immunomodulatory;
- – Antimicrobial;
- – Prebiotic;
- – Mineral-binding;
- – Antithrombic;
- – Hypocholesterolemic.



- .

- Bioactive peptides would be generated in fermented meat products since meat proteins are hydrolyzed by proteolytic enzymes during fermentation and storage.

- Developing functional fermented meat products could be a good strategy in the meat industry.

Probiotics

- A probiotic is known as a culture of living microorganisms which are mainly lactic acid bacteria or bifidobacteria. It can beneficially affect the health of the host when it is ingested at certain levels by preventing the growth of harmful bacteria via competitive exclusion and by generating organic acids and antimicrobial compounds in the colon (Salminen et al., 1996).
- By using probiotic bacteria, potential health benefits can be introduced to meat products.
- Target products with probiotic bacteria are mainly dry sausages, which are processed by fermentation without heat treatment.

Conclusion

- Meat and meat products are the main constituent of the diet however as a part of balanced diet, consumers prefer healthier meat products.
- Fat redeuction process based on selection of lean material, increasing water content and the addition of non-meat additives such as carbohydtares and proteins.
- The success of the fat reducing process could be measured by the functionality, safety, stability and the sensory properties of the product.
- The nutrition composition of meat products can be altered by using bioactive ingredients.
- Technologic and sensory quality of the products depends on the additive selected.
- Further studies need to be done on potential additives.