

THE SCIENCE OF COOKING MEAT

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Cooking is a process that improves the palatability and safety of meat. In the earlier periods of civilization man ate raw meat. The technique of cooking must have developed when he happened to taste meat that had accidentally fallen into fire and had got cooked. In the world majority of the population consumes only meat that is cooked, but a small section of the population prefer to eat meat in its raw state like the Eskimos. In fact the word Eskimo comes from the Algonquin word meaning "eating raw flesh".

Changes in meat on cooking

Cooking coagulates and denatures proteins of meat especially the surface proteins. This alters the solubility of proteins due to loss of characteristic conformation. At temperatures of 60 – 70°C there is toughening of meat due to protein denaturation. This is followed by tenderization at 75.5°C and is due to the gelatinization of collagen. The most heat sensitive protein of meat, α actinin becomes insoluble at 55°C. Myosin and troponin are the most heat resistant proteins of meat and they become insoluble at 80°C. It also results in denaturation of the pigments of meat and changes in colour. The bright red colour of fresh meat is due to oxygenation of myoglobin. During cooking the myoglobin denatures to globin myohaemochromogen and globin myohaemichromogen pigments, which are greyish in colour. During the cooking process the colour of cured meat and meat products get stabilized. The pink pigment, nitric oxide myoglobin of raw cured products is unstable and it gets stabilized during cooking when a stable reddish pigment nitrosyl haemochromogen is produced. The denaturation and coagulation of proteins on the surface is responsible for skin formation in skinless sausages.

Cooking destroys spoilage and pathogenic microorganisms in meat and this depends on duration and temperature of cooking. During certain canning operations "commercial sterilization" of meat occurs and this destroys vegetative cells as well as some spores. Cooking reduces the moisture on the surface thus impairing mould growth.

Heating of meat destroys the indigenous enzymes of meat while they are not destroyed during the irradiation of meat. Irradiated raw meat on prolonged storage may produce bitterness due to proteolysis.

Cooking intensifies the flavour of meat and it changes the "serumy" or "blood like" flavour of raw meat to the pronounced desirable meaty flavour of cooked meat. The sensation of flavour is a combined reaction to odour and taste and depends on various factors.

Flavour of meat differs between species due to the difference in the components of fatty tissues. Flavour is also influenced by sex and is specially noticed in boar meat. As age advances the flavour of meat intensifies. Post slaughter aging of meat also intensifies the flavour of meat. Preslaughter feeding of certain feeds like garlic, onion, clover etc imparts corresponding undesirable flavours to meat. The flavour of meat is influenced by the cooking method. Browning of meat by grilling, roasting, frying etc enhances the flavour of meat by the Maillard/browning reaction. This involves the reaction between amino groups of proteins and carboxyl groups of carbohydrates. When meat is cooked, the outside reaches a higher temperature than the inside, triggering the Maillard reaction and creating the strongest flavors on the surface. Optimum flavour of meat is found in freshly cooked meats when compared to precooked meats kept under refrigeration. Refrigerated meats that have undergone oxidation develop an undesirable flavour called as "warmed over flavour" on heating. To maintain the fresh flavour the cooked meat must be vacuum packed.

The losses during cooking result from evaporation of water and volatiles and melting of fat as drippings. The interior fat is less affected by heating when compared to that in the exterior. The subcutaneous layer of fat prevents excessive loss of water.

Methods of cooking meat

The cooking methods can be broadly classified as

1. Dry heat cooking
2. Moist heat cooking
3. Microwaving

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Often combinations of the above methods are employed in the case of meat.

1. Dry heat cooking: In this method the meat is surrounded by hot air and it is most suited for tender cuts. The common dry heat cooking techniques in meat are broiling, grilling, roasting, baking, sautéing and frying. Most dry heat cooking methods are rather quick processes and they add flavour and crispness to meat, but do not tenderize it.

a. Broiling and grilling: These are dry heat cooking techniques suited for very tender cuts of meat like steaks and chops and for, patties, sliced ham and bacon. In broiling the meat product is supported by a wire grill and is heated. The product has to be turned over when one side is cooked. Broiled meat is cooked very close to the heating element and since it uses such high, direct heat, broiled food gains a pleasantly brown exterior, and it usually takes just a few minutes to prepare. Grilling and broiling are often used interchangeably but they are distinctly different. While both use a radiant heat transfer, the heat source for grilling comes from the bottom, or underneath the food, whereas the heat source for broiling is on top, or above the food. Research suggests that grilled meat may increase the risk of certain types of cancer. Red meats, poultry and fish produce compounds called heterocyclic amines (known carcinogens) when cooked at high temperatures. Another type of carcinogen called polycyclic aromatic hydrocarbons is formed when animal fat drips onto hot coals, which then flame up and deposit the carcinogens on the meat. Selecting lean meat cuts for grilling and trimming away the fatty portions can reduce this carcinogenic effect. The meat must not be pierced by fork in order to prevent escape of fat and juices. Charring should be avoided and if any, the charred portions must be trimmed off.

b. Roasting: This is a dry heat cooking method used for very tender cuts like prime rib roast, beef sirloin, lamb and veal leg and shoulder and pork loin and shoulder. For roasting the meat should be at least 2 1/2 inches thick and is placed in an open roasting pan with fat side up. No liquid is added and the meat is kept uncovered in a hot air oven at a temperature of 250 – 350°F. In this, no turning is required. Low temperature cooking for a long time period results in less shrinkage and the meat is juicier whereas high temperatures result in more shrinkage. However, higher temperatures for a short period improve flavour and impart an attractive brown colour. In the case of poultry and fish, the term baking is commonly used instead of roasting.

c. Sautéing: This is type of dry heat cooking in which there is just a thin coating of fat in the pan (about 1/8" inch). Sautéing uses conduction to transfer the heat from the hot pan to the food.

d. Frying: Frying can be of two types—Pan-frying and deep fat frying.

Pan - frying: This is done in small amount of fat/oil. The food should be partially submerged in fat. The fat should cover approximately 1/3 to 1/2 of the product, which is to be cooked.

Deep fat frying: This is done in large amounts of fat. To deep-fry, the food is entirely submerged in hot fat. Heat is transferred to the food in deep-frying through the conduction of the hot fat, which surrounds the food.

Frying is suited only for small and thin cuts of meat. Enrobed meat products are commonly fried. When cured meat products like bacon are fried there is production of carcinogenic chemicals. This is because the high temperature attained during frying catalyses nitrosation of proline to N – nitrosoproline that is decarboxylated to N – nitrosopyrrolidine, a carcinogen. The nitrite level in bacon is hence limited and chemicals like sodium ascorbate and alpha tocopherol salt are added which reduces the formation of N-nitrosopyrrolidine.

2. Moist heat cooking: This employs the use of hot liquid or steam for cooking. The liquid is kept in constant contact with meat by recirculating it. Closing the container with lid does this. This also causes a slight increase in pressure and temperature and helps in gelatinizing collagen and thus tenderizing the cuts. Moist heat cooking is preferred for tougher meat cuts. Different types of moist heat cooking include:

a. Braising: This is actually a combination of dry and moist heat cooking. In this, meat is at first browned in hot fat in a pan (dry heat). Later moisture like water, milk, vegetable stock or any gravy is added, the pan is tightly closed and meat is simmered at just below boiling point (moist heat).

b. Pot-roasting: This is almost same as braising. Only difference is that vegetables are added at the proper time to be ready to eat with meat.

c. Stewing: This is a moist heat cooking in which small boneless cuts of meat are used. The meat cuts are covered with water or tomato juice, container is closed and cooking is done at simmering temperature. The liquid is then reduced during cooking to thicken the consistency. Vegetables are also added along with meat. The difference between braising and stewing is that for stewing small cuts that are diced are used and for braising larger cuts are used.

d. Pressure-cooking: This is a moist heat cooking very suited for tough cuts of meat. Use of higher-pressure results in higher temperature and the cooking time is also reduced. There is gelatinization of collagen, but there is disintegration of meat into a homogenous mass and meat texture is lost if the end point is not controlled. Also, the cooking losses are high.

e. Simmering: this is a moist heat cooking in which the meat is heated to below boiling point temperature. Commonly done for liver sausages.

3. Microwaving: This makes use of electromagnetic waves usually 915 and 2450 MHz, of which the 2450 MHz is common.

The heart of a microwave cooker is the magnetron, which produces microwaves. Microwaves are directed and reflected from the metal walls back and forth through the food, which is a dielectric substance. The food absorbs energy from electromagnetic field and this energy is converted to heat by intermolecular collisions and the food gets cooked. This type of cooking is different from conventional cooking in that heating is from within the food and not from outside. The air in the microwave oven is commonly cold and only food is heated by microwaves.

Advantages:

1. Cooking is rapid and uniform.
2. There is ease of control.
3. There is lower energy usage.
4. Limited amount of oil is only needed

Disadvantages:

1. There is no browning as in conventional cooking.
2. Metal containers cannot be used since microwaves cannot penetrate metals and special microwave compatible containers are needed.
3. Excessive steaming may produce sogginess of the product.
4. Preferential absorption of microwaves by thawed portions of meat may raise the temperature excessively high while the centre may remain frozen.

5. Speed of heating depends on quantity of load

To impart brownness most microwave ovens are nowadays equipped with conventional electrical heating. Microwave ovens

are very popular in fast food restaurants and homes due to the fast cooking rate.

Doneness of meat: It is the degree to which the meat is cooked. In the food industry, there are six standard levels of doneness for meat, which are very rare, rare, medium rare, medium, well done, and very well done.

Internal temperatures required for various degrees of doneness

Degree of Doneness	Internal temperature
Very rare	130°F
Rare	140°F
Medium rare	145°F
Medium	160°F
Well done	170°F
Very well done	180°F

Rare beef has a brownish exterior and a reddish pink interior and clear red juice whereas a beef cooked to a medium degree of doneness has a light pink interior and less juice. A well-done beef is light brown throughout.

As against the Westerners we prefer to consume meat cooked to well done to very well done. The incorporation of spices and seasonings masks the actual meat flavour. However with the markets being flooded with newer products everyday and the fast changing lifestyles, newer cooking methods are in demand among the consumers.



INFANTS WHEEZE LESS IN HOMES WITH MULTIPLE DOGS

Living in a home with multiple dogs may help reduce an infant's risk for developing wheezing in the first year of life, according to new research from the University of Cincinnati (UC). Cincinnati researchers, led by David Bernstein, MD, have found that infants living in homes with high levels of endotoxins (bacterial contaminants) and multiple dogs were more than two times less likely to wheeze than other infants. They found that wheezing was not associated independently with either dog or cat ownership or high levels of indoor endotoxins; however, high endotoxin exposures in homes that also had multiple dogs resulted in less wheezing. "Our research presents evidence that pet ownership offers a protective effect against development of lower respiratory symptoms in young children," adds Bernstein.

VIEWS

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