M E A T

I T S C O O K E R Y and D I G E S T I O N

by

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MEAT

ITS COOKERY and DIGESTION.

As meat is one of the most common as well as the most necessary articles of diet and is used all over our land by rich and poor, it is very essential from an economical as well as a hygienic point of view, that we should study the effects of the various methods of preparing meat upon its digestibility. The preparation of meats as well as of other foods has advanced and kept pace with the degree of civilization of man. The savage ate his meat with no preparation whatever but just as it was taken from the animal of his prey. As he became more advanced in his ideas and tastes he toasted the meat over an open fire. This brought out additional flavors.

By the use of these toasted meats a taste for the high flavors was cultivated until now meat is cooked at a very high temperature in order to bring out these high flavors regardless of the fact that it is at the same time rendered more indigestible and less nutritious. For we must remember that as in the case of other foods the value of meat does not depend entirely upon the amount of nutrient present but to some extent upon the amount of these nutrients which the body can digest and use for its support.

The term meat as here used includes the several varieties of butchers meat as beef, pork, mutton, game and fowl. The value of meat as a food depends upon two distinct classes of nutrients, viz., protein and fat. The protein is essential for the construction and maintenance of the body while both proteids and fats yield muscular power and maintain the temperature.

The compounds found in meat are very similar to those of the human body therefore they require but little change before they are ready for use. As to the structure of meat it consists of the muscular tissue or lean and the varying quantities of fat, which are found in the different parts or between and with the membranes and tendons. Beside the fats ordinarily visible there are present particles of fat too small to be discerned without the aid of the microscope but which can be obtained by chemical means and weighed. The lean or muscular tissue of meat is made up of numerous visible fibres and these in turn are made of bundles of microscopic tubes known as muscle fibres. These fibres vary in length in the different kinds of meat. In carving, these fibres should be cut at right angles to their axes. The contents of the tube being thus exposed causes the flavor of the meat to be improved. The walls of these tubes consist of an albuminoid substance (Elastin) while the connective tissue is composed of collagen which yields gelatin on boiling.

Meat also contains large and varying quantities of water. The greater the amount of water in a given weight of meat the less the nutritive value. There is relatively a larger percentage of water in lean meat than in fat meat.

There are a great many kinds of nitrogenous compounds in flesh and almost hopeless confusion exists in their classification and in the names assigned to the various classes by different people. All together are however classified as protein. The compounds containing nitrogen are arranged by E.R.Schafer, LL.D., in the following groups:

Proteid

I Albumins - as serum, egg albumen, and lact-albumens.

II Globulins - as fibrinogen, serum, globulin, and myosinogen.

III Albuminates - or proteids derived from either globulins or albumens by the action of weak acid or alkali.

IV Proteoses and peptones - or proteids formed of other proteids by hydrolizing agents.

V Coagulated Proteids - This class includes the proteids that have been reduced by heat and those in which the coagulation has been induced by ferment action such as fibrin, myosin, casein.

These classes form the chief nitrogenous compounds of meat, which constitutes about twenty per cent of its bulk, or weight for weight it contains about five times as much protein as milk. Flesh contains but a very small amount of carbohydrate, only a fraction of one per cent, and this is found stored in the liver and muscles in the form of glycogen.

Mineral matter is also contained in meat which is very essential to the formation of bone. The most important compounds are phosphates of lime, potash and magnesia.

The toughness or tenderness of meat depends upon the walls of the muscle tubes and connective tissue. The flavor however depends largely upon the kinds and amounts of nitrogenous extractives which the tubes contain. Pork and mutton are deficient in extractives and their flavor is largely due to the fats they contain. The flesh of

game and most birds is rich in extractives which accounts for its high flavor. The flesh of young animals is more tender, but it is also true that it is not so highly flavored as that from more mature animals. If meat is allowed to hang and ripen it developes added flavors from the decomposition of the nitrogenous extractives.

Flavoring materials and agreeable appearance do not directly increase the thoroughness of digestion, but serve to stimulate the digestive organs to greater activity. Hence it should be the aim of every cook to preserve the juices and flavors of the meat and serve it in the most tempting manner as well as to sterilize and soften the fibres.

If meat is placed in cold water and allowed to come to a boil, a part of the organic salts, the soluble albumen and the extractives will be dissolved out thus making the meat poorer in flavor but enriching the broth. This method of cooking is used in making soups where the flavor is required in the broth.

Sauteing or cooking meat in about one fourth inch of fat is the ordinary household method of cooking steak, and although the flavor is retained the fibres are exposed to a temperature so high as to coagulate the proteid, likewise the proteid is so surrounded by fat that it is not readily acted upon by the gastric juice.

Pan broiling is cooking meat in a very hot unoiled frying pan, turning it frequently to prevent the temperature from rising too high and also to prevent the meat from sticking to the pan. This method is rapidly becoming popular as it produces a juicy and well flavored meat.

In the ordinary method of boiling meat the juices and salts are extracted and fibres are made tough and stringy by the intenst heat to which they are exposed.

Stewing meat. If the broth and the meat are both to be used the process of cooking should be quite different from the process of boiling. Stewing in this country is a much undervalued method of cooking. This is probably due to the aversion which Americans consciously or unconsciously have to made dishes. This aversion is probably due to the fact that we shun economy or any attempt at economy in diet.

In stewing the meat should be cut into small pieces, placed in cold water and gradually brought to a temperature of 80° C where it should be kept for some hours. Treated in this way the broth will be rich and the meat tender and juicy. If the water is brought much higher than 80° C the meat will become dry and fibrous.

The principal difference between roasting and boiling is in the medium with which the meat to be cooked is surrounded. In boiling the flesh is surrounded by boiling water while in roasting it is in a medium of hot air. In both cases if properly conducted the fibres are cooked in their own juices.

Digestion.

All solid foods are digested in the stomach in a physical sense, that is to say, they are reduced to a fluid or pulp in which condition alone they are able to pass through the intestines. But meat is a food the main share in the chemical digestion of which also

falls to the lot of the stomach. Its chief nutrient constituent proteid is there converted into peptones and proteoses by chemical action of the gastric juice. It is laid down as a rule that the greater extent to which the chemical digestion of a food goes on in the stomach the easier does its mechanical digestion prove. Hence, although meat makes quite a demand upon the gastric juice it does not throw any great strain upon the mechanical resources of the stomach and for that reason must be considered one of the more easily digested solid foods. This makes artificial digestion of meat much easier as very good results may be obtained without the peristaltic action of the stomach.

The first thing to be observed in the digestion of meat is that the fibres swell up and become softened, their color then changes to a grayish yellow, they fall apart and the mass becomes pulpy, and lastly, the individual fibres split longitudinally and the threads are then broken into disks. The longer and thicker the fibre the more slowly are they split. Hence, the improvement in the digestibility of tough meat which results from breaking up the fibres by pounding the meat across its cut end. The influence of cooking is also of great importance in the digestibility of meat.

I will try to show by the following digestion experiments the relative digestibility of meat cooked by the various methods.

In each experiment the meat to be digested was cut very fine with an ordinary meat cutter and ten grams were very accurately weighed and placed in a beaker containing two hundred cubic centimeters of standard juice. The meat was thoroughly mixed with the gastric

juice and the beaker placed in a water bath the temperature of which was 40° C, where it was allowed to stand for three hours, being stirred frequently.

The gastric juice was prepared by taking a two tenths per cent solution of hydrochloric acid and thoroughly mixing with it Parke and Davis'es Powdered Pepsin in the proportion of one gram of pepsin to two hundred cubic centimeters of hydrochloric acid or five grams of pepsin to a liter of the two tenths percent solution of hydrochloric acid.

When the meat had digested for three hours the beakers were removed from this bath and placed in a bath of cold water to arrest the digestion and the contents was filtered through filter paper, the dry weight of which had been previously determined. The filters were then dried in an oven and weighed in weighing bottles the exact weight of which was known.

The part of the meat digested was liquified and so passed through the filter while the undigested portion remained upon the filter and was weighed. After subtracting the weight of the filter paper from the weight of the filter and residue andalso subtracting the weight of the water contained in the ten grams of meat and then taking the amount of residue from the amount of solid material in the ten grams of meat.

I obtained the amount of meat digested. Then in order to find the relative amount digested in the different methods of cooking the per centage of the digested portion to the whole portion of meat was determined.

The percentage of water in meat as determined by W.O.Atwater in the Farmer's Bulletin No. 142 on "Principles of Nutrition and Nutritive Value of Food" was used in each experiment and the loss of water by the different methods of cooking here used was taken from The United States Bulletin, No. 141 on Losses in Cooking Meat by H.S. Grindly, Associate Professor of Chemistry in the University of Illinois.

The Percentage of Water in Meat.

Kind	Percentage of Water.
Pork	41.8%
Mutton	48.5%
Beef	60.7%

The Amount of Water Lost by Cooking Meat.

Method of Preparing.	Percentage of the Water of Uncooked Meat Extracted.
Roasted	17.33%
Sauted	46.86%
Pan Broiled	30.52%
Boiling	45.07%
Cooked at Temperature of 85° C	18.05%

The accompanying table shows the results of seven experiments in the digestion of meats. In the first three experiments three different kinds of raw meat, viz., beef, pork and mutton were used to determine their relative digestibility.

Kind of Meat	Time Digested	Amt. Digested	Percent Digested.
Ex. 1, Beef, raw	3 hrs.	3.3080 g.	.33 2/3%
Ex. 2 Pork, raw	3 hrs.	1.0524 g.	10 1/2%
Ex. 3, Mutton, raw	3 hrs.	4.4991 g.	.44 9/10%

The last four experiments were made with beef cooked by the most common methods as described above, viz., pan broiling, sauteing, boiling and cooking at a temperature of 85° C.

Amounts of beef digested prepared by the various methods:

Method of Preparation	Time of Digestion	Amt. Digested	Percent Digested.
Sauted Beef	3 hrs.	2.5974 g.	25 9/10%
Boiled beef	3 hrs.	2.3961 g.	23 9/10%
Beef cooked at 85° C	3 hrs.	4.3014 g.	43 1/10%
Pan broiled beef	3 hrs	5. 8189 g.	58 1/5%

The above table shows that of the raw meats digested mutton was the most easily digested, beef was somewhat harder to digest and pork was the most difficult of digestion. Thus we may understand why mutton is preferable to beef in the diet of a convalescent fever patient and why pork is seldom given to a patient recovering from any disease which has in any way weakened the digestive tract.

Of the cooked meats experimented with that which was pan broiled was most digestible, the meat cooked at 85° C was very slightly harder to digest while the sauted and boiled meats were much more

difficult to digest than either of the first mentioned.

Therefore, in order to secure the most perfect digestion the lighter cooked meats only should form a part of the diet.