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MEATS: COMPOSITION AND COOKING.

BY

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U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., October 12, 1895.

SIR: I have the honor to transmit herewith, for publication as a Farmers' Bulletin, an article on the composition and cooking of meats, prepared under the immediate direction of Prof. W. O. Atwater, special agent in charge of nutrition investigations, by Mr. Chas. D. Woods, vice-director of the Storrs (Conn.) Experiment Station, and attached to this Office as an expert for nutrition investigations. This bulletin summarizes the results of investigations regarding the nutritive value of different kinds of meat, and points out some of the things which should be considered in the cooking of meats for different purposes. The table appended to this article is based upon all the available data regarding the composition and fuel value of American meats (exclusive of fish), and is believed to be more complete than any similar table hitherto published.

Respectfully,

A. C. TRUE,
Director.

Hon. J. STERLING MORTON,
Secretary.

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ANIMAL AND VEGETABLE FOODS COMPARED.

The food of man can not be healthful and adequate unless it supplies the proper amount of the different nutritive ingredients, or "nutrients." Practical experience proves this, and experimental inquiry demonstrates it as well. Just what the functions of the different foods are—their "nutritive value and cost"—has been discussed in Bulletin No. 142 of this series, and a knowledge of the facts there set forth is necessary to a clear understanding of the present bulletin.

It is natural to divide foods into two classes—animal food and vegetable food. Not only is this division simple and convenient, as pointing out the two great sources of man's food, but the classification is a true one, for the difference between animal and vegetable food is very striking in appearance, composition, and value in the economy of life. It is true that many of the chemical compounds which enter into the composition of these two classes of food are either alike or quite similar; but in general the vegetable foods contain large amounts of carbohydrates—such as sugar, starch, woody fiber, etc.—while the animal foods, and meat in particular, contain only small amounts of these carbohydrates. As regards the fats and nitrogenous matters or "protein," the case is reversed; for vegetable foods have comparatively little of these two classes of nutrients, while meats have relatively very large amounts.

The value of meats as food, therefore, depends on the presence of two classes of nutrients, protein and fat. The protein is essential for the construction and maintenance of the body. Both protein and fat yield muscular power and maintain the temperature. It is possible to combine the fat of animal foods with the protein so as to meet the requirements of the body without waste, but the vegetable foods contain nutrients more especially adapted for the production of energy.

Another difference between animal and vegetable foods is in their digestibility. The compounds contained in the animal foods are, of course, very much like those of our bodies, and therefore need but little change before they are ready for use. The vegetable compounds, on the other hand, require much greater changes before they can be assimilated. They are less readily and less completely digested than the animal foods. This is due in part to the fact that the nutrients of vegetable foods are often inclosed in cells with woody walls, which resist the action of the digestive fluids, and in part to the action of the woody fiber in irritating the lining of the intestine, and thus hastening the food through the intestine before the digestive juices have time to act thoroughly upon the food. Indeed, the presence of the woody fiber frequently prevents the complete digestion and absorption not only of the nutrients contained in the vegetable foods, but also of those contained in the animal foods eaten at the same time.

STRUCTURE OF MEATS.

In the sense in which the word is here used, meat consists of the muscular tissue, or lean, and the varying quantities of fat which are found in the different parts, as between and within membranes and tendons. Besides the fat ordinarily visible there is always present more or less of fat in particles too small to be readily distinguished from the lean which surrounds it. These particles can, however, be readily obtained by chemical methods in quantities sufficient to be seen and weighed.

The lean part of meat has practically the same final structure regardless of its kind and its muscular tissue. All muscular tissue is made up of prism shaped bundles, which can be divided into smaller and smaller bundles, until finally the muscle fibers or tubes are reached. These irregular tubes are so small that they are invisible to the unaided eye. They vary in diameter from $\frac{1}{200}$ to $\frac{1}{1100}$ of an inch.

These muscle fibers or tubes are held together in bundles by means of connective tissue, and the invisible fat is stored between and inside the different fibers and bundles of fibers. Each of the bundles of muscle fibers, seen when a piece of meat is cut "across the grain," as in a round steak, is made up of hundreds of the muscle tubes.

The envelope or wall of each tube is a very delicate, elastic membrane, composed of nitrogenous material. The walls themselves are quite permanent, but their contents are continually undergoing change and renewal.

COMPOSITION OF MEATS.

As regards composition, the meats found in the markets consist of the lean or muscular tissue, connective tissue or gristle, fatty tissue,

blood vessels, nerves, bone, etc. No general statement can be made with regard to the proportion in which these substances occur, as it is found to vary greatly with the kind of animal, with different "cuts" from the same animal, and with many other conditions.

REFUSE, AS BONE, SKIN, ETC.

Nearly all meats bought and sold in the markets contain some portions not suitable for eating, which may properly be designated as refuse. Some of these, as bone, contain some nutriment, and may be utilized to a greater or less extent in making soups, and perhaps in some other ways; but for the most part they are thrown away.

It is important to distinguish between refuse and "waste." As the term is ordinarily used, any portion considered unsuitable for eating would be designated as refuse. At another time or under other conditions, it might be desirable to use for food the portion which was before considered useless. Such portions, therefore, are not refuse in the proper meaning of the term. They are waste. Some parts of meat, however, from their lack of nutrients or from the impossibility of preparing them for food, are and always will be useless, and these portions we may properly call refuse. As population increases there is, however, an increasing tendency to utilize portions of meats which have hitherto been thrown away. If our classification is to be a true one, therefore, we must narrow the use of the term "refuse" from its generally too-broad application and must cover much of its popular meaning by the term "waste." The skin of fish and poultry, "rind" of pork, case of sausages, etc., are illustrations of materials which might by one person be classed as refuse and by another be considered edible and thus be classed as waste if they were rejected at the table.

In ordinary meats the chief refuse is bone. The percentage of bone varies so greatly that no precise statement can be made. In many species of fish, bone constitutes more than one-half the dressed weight. In some cuts of meat, on the other hand, notably the round of beef, slice of ham, and similar cuts in other animals, there may not be more than 2 or 3 per cent of bone, and in still other cuts, as shoulder clod, there will be no bone at all.

In general, the younger the animal the larger the relative proportion of bone, and with increase in fatness there is a relative decrease in the amount of bone.

The following diagram shows graphically the variations in the refuse, chiefly bone, in different kinds and cuts of meats.

The smallest and largest percentages of refuse found in different kinds and cuts of meats.

(6)

WATER.

Meats contain large and varying amounts of water. For the purposes of mastication, swallowing, etc., of course this is better than if the meat were dry; but the water contained in flesh has no greater value as food than other water. From this it follows that the greater the amount of water in a given weight of food the less is its relative nutritive value, for it will contain a less quantity of nutritive material. Fish and oysters have relatively more water than most other meats. In general, the greater the amount of fat in a given cut the less is the amount of water. For instance, a lean cut of beef may have 75 per cent of water, while a fat cut from the same animal may not contain more than 50 per cent.

The diagram on page 8 illustrates the variations in the quantity of water in the edible portions of different kinds and cuts of meats.

FATS.

All meats contain some fat, partly stored in quantities so large as to be readily seen, and partly distributed in such small particles that it is only by chemical means that it can be obtained in quantities sufficient to be appreciated. In the flesh of some animals, as cod and other white-meated fish, and in chicken (young fowl), rabbit, and veal, there is little or no visible fat. In a very fat ox, on the other hand, one-fourth of the weight of meat may be visible fat, and, in the case of fat hogs, more than half the weight may be fat. No flesh is so lean as not to contain at least minute portions of fat. Very lean flesh, as dried beef, may not have more than 3 per cent of fat, while fat pork may contain more than 90 per cent.

Fat is a valuable constituent of food. It is used in the body to form fatty tissue and is consumed as fuel, thus serving to maintain the animal temperature and to yield energy in the form of muscular and other power. It is the most concentrated form in which the fuel constituents of food are found. Its fuel value is two and one-fourth times that of protein or the carbohydrates. In other words, 1 pound of fat yields as much heat when burned as 2¼ pounds of carbohydrates, such as starch, sugar, etc. The fat of animal foods might be so supplied that, together with animal protein, all the needs of the body could be met. The fuel constituents of vegetable foods are, however, better adapted to furnish a large part of the energy required by the body.

The diagram on page 9 illustrates the variations in the percentage of fats in the edible portions of different kinds and cuts of meats.

The smallest and largest percentages of water found in the edible portion of different kinds and cuts of meat.

Kind of meat.	Per cent.	Comparative scale.
Beef:		
Side	from 48 to 72	
Sirloin	from 51 to 75	
Round	from 57 to 75	
Hind shank	from 61 to 74	
Shoulder and clod	from 62 to 75	
Veal:		
Side	from 69 to 74	
Chops	from 61 to 75	
Cutlet	from 67 to 77	
Mutton:		
Side	from 39 to 59	
Chops	from 31 to 56	
Leg	from 52 to 68	
Pork:		
Chops	from 38 to 60	
Smoked ham	from 22 to 57	
Fat, salt	from 0 to 12	
Halibut steak	from 70 to 79	
Cod	from 81 to 84	
Mackerel	from 64 to 79	
Shad	from 65 to 74	
Oysters	from 82 to 91	
Long clams	from 85 to 86	
Lobster	from 79 to 84	

The smallest and largest percentages of fat in the edible portion of different kinds and cuts of meat.

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NITROGENOUS CONSTITUENTS (PROTEIN).

There are a great many kinds of nitrogenous compounds in flesh, and an almost hopeless confusion exists in their classification and in the names assigned to the various classes by different chemists. Chemists are quite generally agreed, however, in designating the total nitrogenous substance as protein. These compounds containing nitrogen may be arranged in the following three groups or classes:

PROTEIN:

Albuminoids, as albumen (white of eggs); casein (curd) of milk; myosin, the basis of muscle (lean meat); gluten of wheat, etc.

Gelatinoids, as collogen of tendons and ossein of bones, which yield gelatin or glue, etc.

Nitrogenous extractives.—Meats and fish contain very small quantities of so-called extractives. They include creatin and allied compounds, sometimes called meat bases, and are the chief ingredients of beef tea and meat extract.

The nitrogenous compounds of meats are made up chiefly of albuminoids and gelatinoids. The albuminoids are so called because they resemble albumen or white of egg in their properties, and the gelatinoid substances are so named because of their similarity to gelatin. They are easily changed into gelatin by the action of hot water or steam, as in the manufacture of gelatin and glue from bones.

The value of meats as food is chiefly due to the nitrogenous compounds which they contain, and of these the most valuable are the albuminoids. This is due to the fact that they are very similar in composition to the nitrogenous compounds of the body, and are therefore easily digested and assimilated. Experiments with sheep, swine, dogs, and other animals seem to show that feeding rich, nitrogenous foods considerably increases the percentage of albuminoids in the flesh.

Very different views have been held at different times as to the value of gelatin as a food. At one time it was considered nearly as valuable as the albuminoids themselves; but later, from the investigations of the "French Gelatin Commission," it fell into disrepute and was held to have almost no food value. Later and better conducted experiments, however, have demonstrated that gelatin, when combined with albuminoids and extractives, has a very considerable nutritive value and serves to economize the albuminoids.

The last class, known as nitrogenous extractives, or meat bases, are so called because of the ease with which they may be dissolved out (extracted) by water. They are formed by the decomposition (cleavage) of albuminoids and probably gelatinoids. They consist largely of creatin and creatinin, substances which somewhat resemble thein and caffein, the active principles of tea and coffee. They are of little value as food, but they give flavor to meats, and are therefore of great importance. They will be referred to again when we come to consider the flavor of meats, soups, and meat extracts.

The lean of meat has, in round numbers, about 20 per cent of protein, or, weight for weight, about five times as much as milk. The flesh

of fowls, especially wild fowl, has on the average more protein than beef, and the flesh of fish has less.

While protein is the most important and valuable ingredient of food, lean flesh is, nevertheless, a one-sided diet, and to make a well-balanced ration for man the addition of foods containing carbon, such as fat, starches, sugar, etc., is necessary.

The diagram on page 12 illustrates the variations in protein in the edible portions of different kinds and cuts of meats.

CARBOHYDRATES AND ASH.

Although carbohydrates occur in considerable quantities in other foods, flesh contains but a small amount—only a fraction of 1 per cent—and that chiefly in the form of glycogen, or muscle sugar. In some of the organs, notably the liver, there are considerable quantities of glycogen.

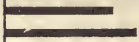
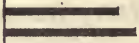
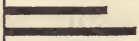
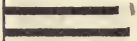
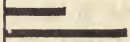
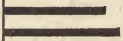
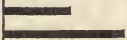
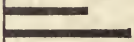
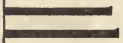
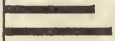
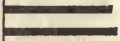
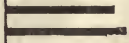
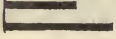
Meats also contain more or less of mineral matters (ash) which have value as food. The most important of these are the phosphates of potash, lime, and magnesia. These are used chiefly in the formation of bone.

TEXTURE (TOUGHNESS) OF MEATS.

Whether meats are tough or tender depends upon two things—the character of the walls of the muscle tubes and the character of the connective tissues which bind the tubes and muscles together. In young and well-nourished animals the tube walls are thin and delicate, and the connective tissue is small in amount. As the animals grow older, or are made to work (and this is particularly true in the case of poorly nourished animals), the walls of the muscle tubes and the connective tissues become thick and hard. This is the reason why the flesh of young, well-fed animals is tender and easily masticated, while the flesh of old, hard-worked, or poorly fed animals is often so tough that prolonged boiling, or roasting, seems to have but little effect on it.

After slaughtering, meats undergo marked changes in texture. These changes can be grouped under three classes or stages. In the first stage, when the meat is just slaughtered, the flesh is soft, juicy, and quite tender. In the next stage the flesh stiffens and the meat becomes hard and tough. This condition is known as *rigor mortis* and continues until the third stage, when the first changes of decomposition set in. In hot climates the meat is commonly eaten in either the first or second stage. In cold climates it is seldom eaten before the second stage, and generally, in order to lessen the toughness, it is allowed to enter the third stage, when it becomes soft and tender, and acquires added flavor. The softening is due in part to the formation of lactic acid, which acts upon the connective tissue. The same effect may be produced, though more rapidly, by macerating the meat with weak vinegar. Meat is sometimes made tender by cutting the flesh into thin slices and pounding it across the cut ends until the fibers are broken.

The smallest and largest percentages of protein in the edible portion of different kinds and cuts of meats.

Kind of meat.	Per cent.	Comparative scale.
Beef:		
Side	from 15 to 21	
Sirloin	from 10 to 21	
Round	from 18 to 22	
Hind shank	from 19 to 22	
Shoulder clod	from 17 to 22	
Veal:		
Side	from 19 to 20	
Chops	from 18 to 21	
Cutlet	from 19 to 21	
Mutton:		
Side	from 12 to 17	
Chops	from 10 to 20	
Leg	from 17 to 19	
Pork:		
Chops	from 11 to 20	
Smoked ham	from 14 to 21	
Fat, salt	from 1 to 5	
Halibut steak	from 18 to 19	
Cod	from 15 to 18	
Mackerel	from 18 to 19	
Shad	from 18 to 20	
Oysters	from 4 to 9	
Long clams	from 8 to 9	
Lobster	from 12 to 18	

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FLAVOR OF MEATS.

The toughness or tenderness of meat, as has been stated above, is dependent upon the walls of the muscle tubes and the 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 what flavor they possess is due largely to the fats contained in them. The flesh of birds and of most game is very rich in extractives, which accounts for its high flavor. In general the flavor of any particular meat is largely modified by the condition of the animal when slaughtered, and by its food, age, breed, etc. We have seen that 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. In most cases, also, the flesh of males is more highly flavored than that of females. There are two exceptions to this rule. The flesh of the goose is more highly flavored than that of the gander, and in the case of pork there is little difference between the flesh of the male and that of the female. Castration, as illustrated in the familiar example of the capon, makes the flesh more tender, fatter, and better flavored.

With the exception of fish, the flesh of animals which feed exclusively upon fish or flesh has a strong, disagreeable taste, and is eaten only by uncivilized people or those in great need. As regards ordinary meat, however, it is enough to say that the nitrogenous extractives, and hence the flavor, depend mainly upon the age of the animal and the character of its food.

Meat which is allowed to hang and ripen develops added flavors. In the first stages of decomposition compounds quite similar to the nitrogenous extractives are formed, and it is to these that the added flavors are due. Game is sometimes allowed to hang until the decomposition changes have gone so far as to be offensive to one whose taste is not educated to enjoy the flavor of "high" meat.

DIGESTIBILITY OF MEATS.

We must remember that, as in the case of other foods, the value of meats does not depend entirely upon the amount of nutrients which they contain, but to some extent upon the amount of these nutrients which the body can digest and use for its support. Digestion proper consists of the changes which the food undergoes in the digestive tract, where the digestible portion is prepared to be taken up by the blood and lymph. These changes are chemical processes, and we can determine quite readily by experiment how much of each nutrient will be digested, but this line of research is new and the methods are not yet perfectly matured.

Comparatively little attention has been given to the percentages of the different meats which are digested; but the facts so far obtained

seem to indicate that flesh of all kinds, either raw or cooked, is quite completely digested by a healthy man. Rubner found that when given in quantities of not more than 2 pounds per day all but 3 per cent of the dry matter of roasted beef was digested by a healthy man. From other experiments roasted flesh seems to be rather more *completely* digested than either raw or boiled meat, but raw meat is more *easily* digested than cooked (boiled or roasted).

A far larger number of experiments and observations have been made upon the digestive processes which pertain to the stomach than upon complete digestion. This is partly due to the hygienic importance of stomach digestion (for a large part of the digestive disorders occur in the stomach) and partly to the ease with which observations of stomach digestion can be made. Much is said about "ease of digestion," by which is usually meant the rapidity with which certain foods pass out of the stomach into the intestine, where the principal work of digestion actually takes place. Roast chicken and veal are tender, easily masticated, well flavored and appetizing, and, so far as the stomach or gastric digestion is concerned, are easily and rapidly digested. This agrees with the practice of using the so-called "white meats" in diets for the sick room. The rapidity of gastric digestion of this class of foods is due to the tenderness of the muscular tissues, and to the fact that this kind of meat contains almost no fat. Fat meats, as beef and mutton, are much less quickly passed out of the stomach, and gastric digestion in the case of fat pork is especially difficult. Although gastric digestion is important, it is by no means a measure of the digestibility of a food.

The question of the digestibility of food in the broad sense is a very complex one, and there is much room for investigation in this field of research in learning the quantities of nutrients which are digested from different kinds of meats, in studying the effects of cooking, in determining the influence of different substances and conditions upon digestion, and in the study of numerous other questions. Until these investigations and experiments shall have been made, it will not be possible to affirm much more about the digestibility of meats than the simple but important statement that nearly all the protein and about 95 per cent of the fats are digested by the average person.

THE COOKING OF MEATS.

Uncivilized man differs from civilized man in no more striking way than in the preparation of food. The former takes his nourishment as it is offered by nature; the latter prepares his food before eating, and in ways which are the more perfect the higher his culture.

Meat is rarely eaten raw by civilized people. For the most part it is either roasted, stewed, fried, or boiled. Among the chief objects of cooking are the loosening and softening of the tissues, which facilitates

digestion by exposing them more fully to the action of the digestive juices. Another important object is to kill parasites, and thus render harmless organisms that might otherwise expose the eater to great risks. Minor, but by no means unimportant, objects are the coagulation of the albumen and blood so as to render the meat more acceptable to the sight, and the development and improvement of the natural flavor, which is often accomplished in part by the addition of condiments.

Flavoring materials and an agreeable appearance do not directly increase the thoroughness of digestion, but serve to stimulate the digestive organs to greater activity. As regards the actual amount digested, this stimulation is probably not of so great moment as is commonly supposed. Meat that has been extracted with water so as to be entirely tasteless has been found in actual experiment to be as quickly and completely digested as an equal weight of meat roasted in the usual way.

In general, it is probably true that cooking diminishes the ease of digestion of most meats. Cooking certainly can not add to the amount of nutritive material in meat; and it may, as we shall see, remove considerable quantities of the nutrients.

BOILING.

If it is desired to heat the meat enough to kill parasites or bacteria in the inner portions of the cut, the piece must be exposed to the action of heat for a long time. Ordinary methods of cooking are seldom sufficient. In a piece of meat weighing 10 pounds the temperature of the interior, after boiling four hours, was only 190° F. The inner temperature of meat when roasting has been observed to vary from 160° to 200° F., according to the size of the piece. In experiments upon the canning of meat it was found that when large and even small cans were kept for some time in a salt-water bath at a temperature considerably above the boiling point of water, the interior temperature of the meat rose to 208° in some cases and only 165° in others. Large cans of meat are more liable to have bad spots than smaller cans, because the heat in them is not sufficient to destroy the bacteria or other organisms that cause the meat to decompose.

If meat is placed in cold water, part of the organic salts, the soluble albumen, and the extractives or flavoring matters will be dissolved out. At the same time small portions of lactic acid are formed, which act upon the meat and change some of the insoluble matters into materials which may also be dissolved out. The extent of this action and the quantity of materials which actually go into the solution depend upon three things—the amount of surface exposed to the water, the temperature of the water, and the length of the time of the exposure. The smaller the pieces the longer the time, or the hotter the water the

richer will be the broth and the poorer the meat. If the water is heated gradually, more and more of the soluble materials are dissolved. At a temperature of about 134° F. the soluble albumen will begin to coagulate, and at 160° F. the dissolved albumen will rise as a brownish scum to the top, and the liquid will become clear. Upon heating still higher, the connective tissues begin to be changed into gelatin, and are partly dissolved out, while the insoluble albuminoids are coagulated. The longer the action of the hot water continues, the tougher and more tasteless the meat becomes, but the better the broth. Treated in this way flesh may lose over 40 per cent by weight. This loss is principally water, but from 5 to 8 per cent may be made up of the soluble albumen, gelatin, mineral matters, organic acids, muscle sugar, and flavoring materials. Part of the melted fat also goes into the broth.

It would be a great mistake to assume that the nearly tasteless mass of fibers which is left undissolved by the water has no nutritive value. This tasteless material has been found to be as easily and completely digested as the same weight of ordinary roast. It contains nearly all the protein of the meat, and, if it is properly combined with vegetables, salt, and flavoring materials, makes an agreeable as well as nutritive food.

If a piece of meat is plunged into boiling water or very hot fat the albumen on the entire surface of the meat is quickly coagulated, and the enveloping crust thus formed resists the dissolving action of water and prevents the escape of the juices and flavoring matters. Thus cooked, the meat retains most of its flavoring matters and has the desired meaty taste. The resulting broth is correspondingly poor.

The foregoing statements will be of much help in the rational cooking of meats in water. The treatment depends largely upon what it is desired to do. It is impossible to make a rich broth and have a juicy, highly flavored piece of boiled meat at the same time. If the meat alone is to be used, the cooking in water should be as follows: Plunge the cut at once into a generous supply of boiling water and keep the water at the boiling point, or as near boiling as possible, for ten minutes, in order to coagulate the albumen and seal the pores of the meat; the coating thus formed will prevent the solvent action of the water and the escape of the soluble albumen and juices from the inner portions of the meat. But if the action of the boiling water should be continued, the whole interior of the meat would, in time, be brought near the temperature of boiling water, and all the albumen would be coagulated and rendered hard. Instead of keeping the water at the boiling point (212° F.), therefore, the temperature should be allowed to fall to about 180° F., when the meat could be thoroughly cooked without becoming hard. A longer time will be required for cooking meat in this way, but the albumen will not be firmly coagulated, and the flesh will be

tender and juicy instead of tough and dry, as will be the case when the water is kept boiling, or nearly boiling, during the entire time of cooking.

In boiling sections of delicate fish, as salmon, cod, or halibut, the plunging into boiling water is objectionable because the motion of the boiling water tends to break the fish into small pieces. Fish should be first put into water that is on the point of boiling. The water should be kept at this temperature for a few minutes and then allowed to fall to 180° F., as in the case of meats.

STEWING.

If both the broth and the meat are to be used, the process of cooking should be quite different from that outlined for boiling meat. Stewing is in this country a much undervalued method of cooking. This is probably due partly to the fact that stewing is generally very improperly done, and partly to the general aversion which Americans, consciously or unconsciously, have to "made dishes" of any kind. This aversion probably has its origin in a false notion which spurns economy or any attempt at economy in diet.

In stewing, the meat should be cut into small pieces, so as to present relatively as large a surface as possible, and, instead of being quickly plunged into hot water, should be put into cold water in order that much of the juices and flavoring materials may be dissolved. The temperature should then be slowly raised until it reaches about 180° F., where it should be kept for some hours. Treated in this way, the broth will be rich and the meat still tender and juicy.

If the water is made much hotter than 180° F. the meat will be dry and fibrous. It is true that if a high temperature is maintained long enough the connective tissues will be changed to gelatin and partly dissolved away, and the meat will apparently be so tender that if touched with a fork it will fall to pieces. It will be discovered, however, that no matter how easily the fibers come apart, they offer considerable resistance to mastication. The albumen and fibrin have become thoroughly coagulated, and while the fibers have separated from each other the prolonged boiling has only made them drier and firmer.

BROTHS, SOUPS, MEAT EXTRACTS.

The quantities of the ingredients in a meat broth may be illustrated by a German experiment. One pound of beef and 7 ounces of veal bones gave about a pint of strong broth or soup, which contained, by weight: Water, 95.2 per cent; protein, 1.2 per cent; fat, 1.5 per cent; extractives, 1.8 per cent; and mineral matters, 0.3 per cent.

Very palatable broths can be made by using more water and adding savory herbs. Broths thus made have, of course, a greater amount of water, frequently as much as 98 per cent, or even more, and the nutrients

are correspondingly reduced in amount. It would appear from the analysis given above that the amount of solids in broths is generally small. Consequently their strong taste and stimulating effect upon the nervous system must be ascribed to the meat bases (flavoring matters) and to the salts of potash which they contain. Besides meat bases, soups contain more or less gelatin, varying directly with the quantity of bones used in the preparation.

The term meat extract is commonly applied to a large number of preparations of very different character. They may be conveniently divided into three classes: (1) True meat extracts; (2) meat juice obtained by pressure and preserved, compounds which contain dried pulverized meat, and similar preparations; and (3) albumose or peptose preparations, commonly called predigested foods.

The true meat extract, if pure, contains little else besides the flavoring matters of the meat from which it is prepared, together with such mineral salts as may be dissolved out. It should contain no gelatin or fat, and can not, from the way in which it is made, contain any albumen. It is, therefore, not a food at all, but a stimulant, and should be classed with tea, coffee, and other allied substances. It should never be administered to the sick except as directed by competent medical advice. Its strong, meaty taste is deceptive, and the person depending upon it alone for food would certainly die of starvation. Such meat extracts are often found useful in the kitchen for flavoring soups, sauces, etc. Broth and beef tea as prepared ordinarily in the household contain more or less protein, gelatin, and fat, and therefore are foods as well as stimulants. The proportion of water in such compounds is always very large.

The preserved meat juice and similar preparations contain more or less protein, and therefore have some value as food.

The third class of preparations is comparatively new. The better ones are really what they claim to be—predigested foods. They contain the soluble albumoses (peptoses), etc., which are obtained from meat by artificial digestion. Their use should be regulated by competent medical advice.

ROASTING.

The principal difference between roasting and boiling is in the medium in which the meat is cooked. In boiling, the flesh to be cooked is surrounded by boiling water; in roasting, by hot air, although in roasting proper much of the heat comes to the joint as "radiant" heat. In both cases, if properly conducted, the fibers of the meats are cooked in their own juices.

When the meat alone is to be eaten, either roasting, broiling, or frying in deep fat is, when properly done, a more rational method than boiling, for the juices are very largely saved. The shrinkage in a roast of meat during cooking is chiefly due to a loss of water. At the same

time small amounts of carbon and nitrogen are driven off and a little acid is produced which dissolves some of the constituents of the meat. The fat undergoes a partial decomposition into fatty acids and glycerin, and a little of it is volatilized.

It is interesting and at the same time important to remember that the smaller the cut to be roasted the hotter should be the fire. An intensely hot fire coagulates the exterior and prevents the drying up of the meat juices. This method would not, however, be applicable to large cuts, because meats are poor conductors of heat, and a large piece of meat exposed to this intense heat would become burned and changed to charcoal on the exterior long before the heat could penetrate to the interior. Hence the rule: The smaller the cut to be roasted, the higher the temperature to which it should be exposed.

The broiling of a steak or a chop is done on exactly this principle. An intense heat should be applied to thoroughly coagulate the albumen and stop the pores, and thus prevent the escape of the juices. A steak exposed to an intense heat for ten minutes is thoroughly cooked, and has yet that rare, juicy appearance which is so desirable.

CUTS OF MEAT.

The methods of cutting sides of beef, veal, mutton, and pork into parts, and the terms used for the different "cuts," as these parts are commonly called, vary in different localities. The analyses here reported apply to cuts as indicated by the following diagrams. These show the positions of the different cuts, both in the live animal and in the dressed carcass as found in the markets. The lines of division between the different cuts will vary slightly, according to the usage of the local market, even where the general method of cutting is as here indicated. The names of the same cuts likewise vary in different parts of the country.

CUTS OF BEEF.

The general method of cutting up a side of beef is illustrated in fig. 1, which shows the relative position of the cuts in the animal and in a dressed side. The neck piece is frequently cut so as to include more of the chuck than is represented by the diagrams. The shoulder clod is usually cut without bone, while the shoulder (not indicated in diagram) would include more or less of the shoulder blade and of the upper end of the fore shank. Shoulder steak is cut from the chuck. In many localities the plate is made to include all the parts of the forequarter designated on the diagrams as brisket, cross-ribs, plate and navel, and different portions of the plate, as thus cut, are spoken of as the "brisket end of plate" and "navel end of plate." This part of the animal is largely used for corning. The ribs are

frequently divided into first, second, and third cuts, the latter lying nearest the chuck and being slightly less desirable than the former. The chuck is sometimes subdivided in a similar manner the third cut

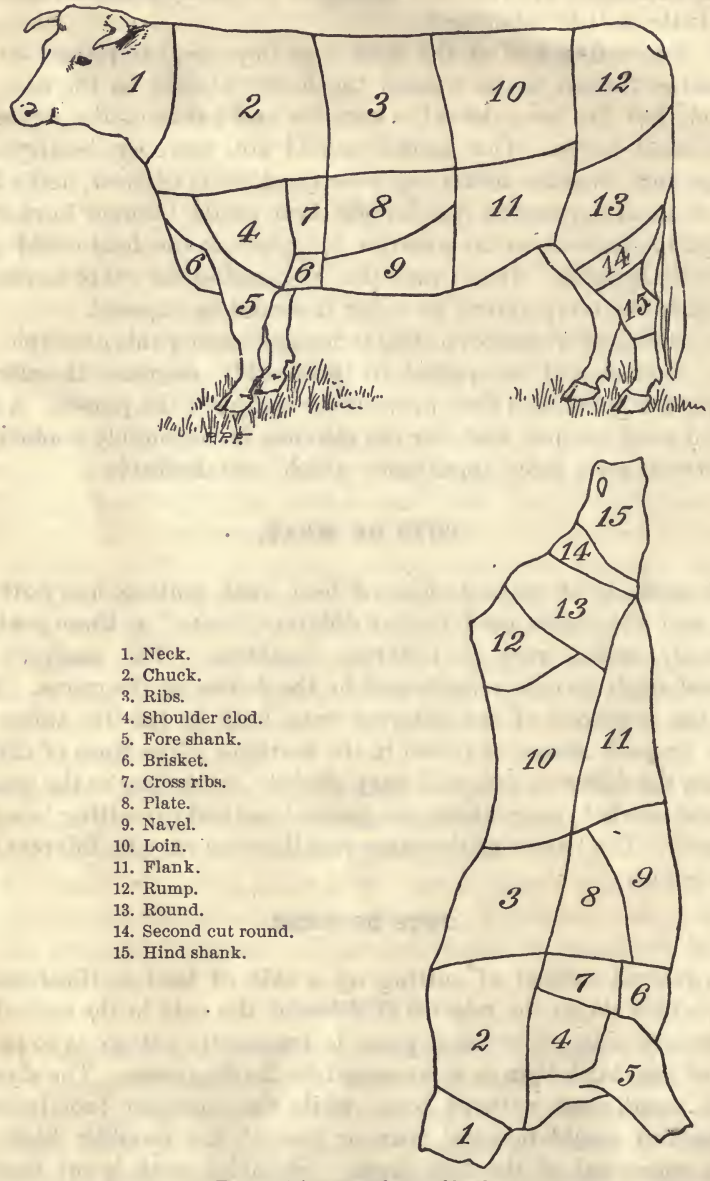


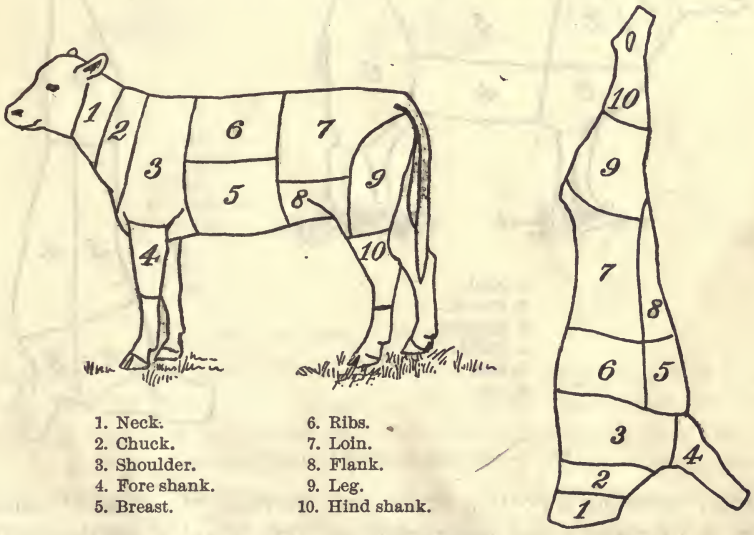
FIG. 1.—Diagrams of cuts of beef.

of the chuck being nearest the neck. The names applied to different portions of the loin vary considerably in different localities. The part nearest the ribs is freqently called "small end of loin" or "short

steak." The other end of the loin is called "hip sirloin" or "sirloin." Between the short and the sirloin is a portion quite generally called the "tenderloin," for the reason that the real tenderloin, the very tender strip of meat lying inside the loin, is found most fully developed in this cut. Porterhouse steak is a term most frequently applied to either the short steak or the tenderloin. It is not uncommon to find the flank cut so as to include more of the loin than is indicated in the figures, in which case the upper portion is called "flank steak." The larger part of the flank is, however, very frequently corned, as is also the case with the rump. In some markets the rump is cut so as to include a portion of the loin, which is then sold as "rump steak." The portion of the round on the inside of the leg is regarded as more tender than that on the outside, and is frequently preferred to the latter. As the leg lies upon the butcher's table this inside of the round is usually on the upper, or top side, and is therefore called "top round." Occasionally the plate is called the "rattle."

CUTS OF VEAL.

The method of cutting up a side of veal differs considerably from that employed with beef. This is illustrated by fig. 2, which shows the relative position of the cuts in the animal and in a dressed side.



1. Neck.
2. Chuck.
3. Shoulder.
4. Fore shank.
5. Breast.
6. Ribs.
7. Loin.
8. Flank.
9. Leg.
10. Hind shank.

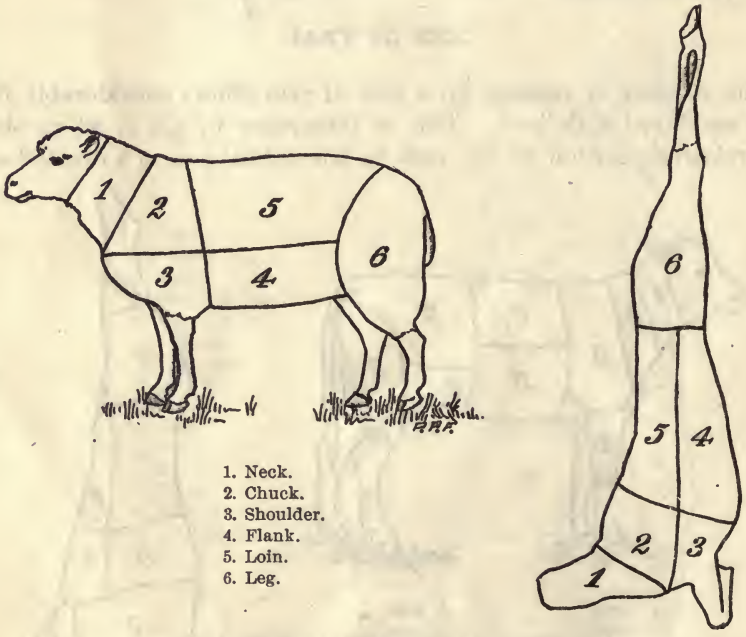
FIG. 2.—Diagrams of cuts of veal.

The chuck is much smaller in proportion, and frequently no distinction is made between the chuck and the neck. The chuck is often cut so as to include a considerable of the portion here designated as shoulder, following more nearly the method adopted for subdividing beef. The

shoulder of veal as here indicated includes, besides the portion corresponding to the shoulder in beef, the larger part of what is here classed as chuck in the adult animal. The under part of the forequarter, corresponding to the plate in the beef, is often designated as breast in the veal. The part of the veal corresponding to the rump of beef is here included with the loin, but is often cut to form part of the leg. In many localities the fore and hind shanks of veal are called the "knuckles."

CUTS OF LAMB AND MUTTON.

Fig. 3 shows the relative position of the cuts in a dressed side of mutton or lamb and in a live animal. The cuts in a side of lamb and mutton number but six, three in each quarter. The chuck includes the ribs as far as the end of the shoulder blades, beyond which comes the loin. The flank is made to include all the under side of the animal. Some butchers, however, make a larger number of cuts in the fore-



1. Neck.
2. Chuck.
3. Shoulder.
4. Flank.
5. Loin.
6. Leg.

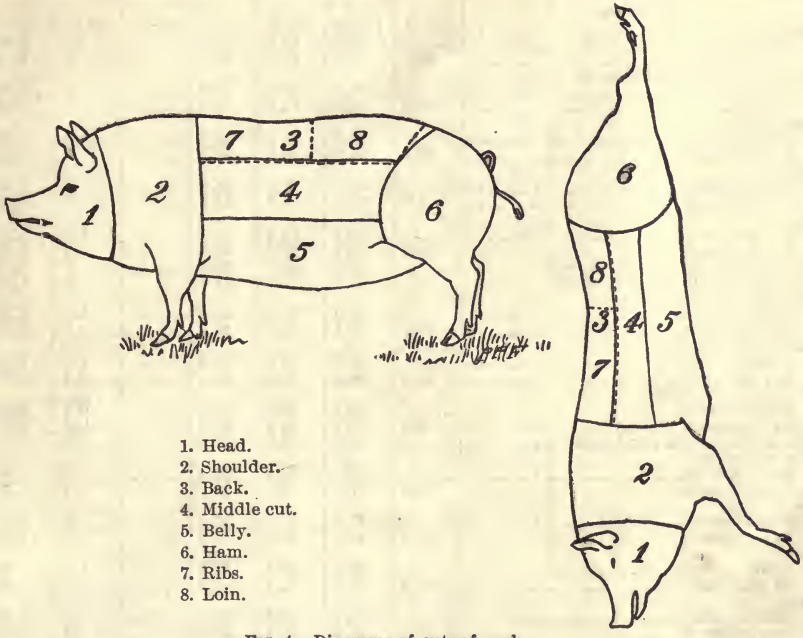
FIG. 3.—Diagrams of cuts of lamb and mutton.

quarter, including a portion of the cuts marked "loin" and "chuck" in fig. 3, to make a cut designated as "rib," and a portion of the "flank" and "shoulder" to make a cut designated as "brisket." The term "chops" is ordinarily used to designate portions of either the loin, ribs, chuck or shoulder, which are either cut or "chopped" by the butcher into pieces suitable for frying or broiling. The chuck and ribs are sometimes called the "rack."

CUTS OF PORK.

The method of cutting up a side of pork differs considerably from that employed with other meats. A large portion of the carcass of a dressed pig consists of almost clear fat. This furnishes the cuts which are used for "salt pork" and bacon. Fig. 4 illustrates a common method of cutting up pork, showing the relative position of the cuts in the animal and in the dressed side. The cut designated as "back cut" is almost clear fat and is used for salting and pickling. The "middle cut" is the portion quite generally used for bacon and for "lean ends" salt pork. The belly is salted or pickled or may be made into sausages.

Beneath the "back cut" are the ribs and loin, from which are obtained "spareribs," "chops," and roasting pieces, here designated by



1. Head.
2. Shoulder.
3. Back.
4. Middle cut.
5. Belly.
6. Ham.
7. Ribs.
8. Loin.

FIG. 4.—Diagrams of cuts of pork.

dotted lines. The hams and shoulders are more frequently cured, but are also sold fresh as pork "steak." The tenderloin proper is a comparatively lean and very small strip of meat lying under the bones of the loin and usually weighing a fraction of a pound. Some fat is usually trimmed off from the hams and shoulders, which is called "ham and shoulder fat," and is often used for sausages, etc. What is called "leaf lard," at least in some localities, comes from the inside of the back. It is the kidney fat.

As stated above, cuts as shown in the diagrams herewith correspond to those of which analyses are reported in the table beyond, but do not attempt to show the different methods of cutting followed in markets in different parts of the United States.

COMPOSITION AND FUEL VALUE OF MEATS.

Within recent years analyses of a large number of samples of meat have been made in this country. In the table below, the average results of these analyses are given. Analyses of fish are not included, because the subject of the composition and nutritive value of fish is fully treated in another bulletin of this series.[a]

Average chemical composition of different kinds of meat.

Food materials.	Refuse.	Water.	Protein (N × 6.25).	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
BEEF, FRESH.							
Brisket:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Edible portion	.....	54.6	15.8	28.5	.....	0.9	1,495
As purchased	23.3	41.6	12.0	22.3	.....	.6	1,165
Chuck, including shoulder:							
Edible portion	.....	65.0	19.2	15.4	.....	.9	1,005
As purchased	17.3	54.0	15.8	12.5	.....	.7	820
Chuck rib:							
Edible portion	.....	66.8	19.0	13.4	.....	1.0	920
As purchased	19.1	53.8	15.3	11.1	.....	.8	755
Flank:							
Edible portion	.....	59.3	19.6	21.1	.....	.9	1,255
As purchased	5.5	56.1	18.6	19.9	.....	.8	1,185
Loin:							
Edible portion	.....	61.3	19.0	19.1	.....	1.0	1,155
As purchased	13.3	52.9	16.4	16.9	.....	.9	1,020
Loin, boneless strip, as purchased[b]	.....	66.3	17.8	16.7	.....	.8	1,035
Loin, sirloin butt, as purchased[b]	.....	62.5	19.7	17.7	.....	.9	1,115
Loin, porter house steak:[b]							
Edible portion	.....	60.0	21.9	20.4	.....	1.0	1,270
As purchased	12.7	52.4	19.1	17.9	.....	.8	1,110
Loin, sirloin steak:[b]							
Edible portion	.....	61.9	18.9	18.5	.....	1.0	1,130
As purchased	12.8	54.0	16.5	16.1	.....	.9	985
Loin, top of sirloin:[b]							
Edible portion	.....	42.2	13.8	43.7	.....	0.8	2,100
As purchased	3.2	40.9	13.3	42.3	.....	.7	2,030
Loin, tenderloin, as purchased:[b]	.....	59.2	16.2	24.4	.....	.8	1,330
Loin, trimmings:[b]							
Edible portion	.....	55.0	16.9	28.0	.....	.8	1,495
As purchased	48.8	27.9	8.5	14.7	.....	.4	780
Navel:							
Edible portion	.....	47.6	15.6	36.5	.....	.8	1,830
As purchased	11.4	42.2	13.8	32.3	.....	.7	1,620
Neck:							
Edible portion	.....	66.3	20.7	12.7	.....	1.0	920
As purchased	31.2	45.3	14.2	9.2	.....	.7	650
Plate:							
Edible portion	.....	56.3	16.8	26.9	.....	.8	1,450
As purchased	19.8	44.4	13.1	22.7	.....	.6	1,200
Ribs:							
Edible portion	.....	57.0	17.8	24.6	.....	.9	1,370
As purchased	20.1	45.3	14.4	20.0	.....	.7	1,110
Rib rolls, as purchased	.....	64.8	19.4	15.5	.....	.9	1,015
Rib trimmings:							
Edible portion	.....	54.7	16.9	28.4	.....	.8	1,515
As purchased	34.1	35.7	11.0	19.2	.....	.5	1,015
Ribs, cross:							
Edible portion	.....	54.9	15.9	28.2	.....	.8	1,485
As purchased	12.5	48.0	13.8	24.8	.....	.7	1,305
Round:							
Edible portion	.....	67.8	20.9	10.6	.....	1.1	835
As purchased	8.5	62.5	19.2	9.2	.....	1.0	745
Round, second cut:							
Edible portion	.....	69.8	20.4	8.6	.....	1.1	740
As purchased	19.5	56.2	16.4	6.9	.....	.9	595
Rump:							
Edible portion	.....	57.9	18.7	23.1	.....	.9	1,325
As purchased	19.0	46.9	15.2	18.6	.....	.8	1,065
Shank, fore:							
Edible portion	.....	70.3	21.4	8.1	.....	.9	740
As purchased	38.3	43.2	13.2	5.2	.....	.6	465

[a] U. S. Dept. Agr., Farmers' Bul. 85. [b] All loin parts are included under analyses of "loin."

Average chemical composition of different kinds of meat—Continued.

Food materials.	Refuse.	Water.	Protein (N × 6.25).	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
BEEF, FRESH—continued.							
Shank, hind:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Edible portion	.....	69.6	21.7	8.7	.....	1.0	770
As purchased	55.4	31.0	9.7	3.9	.....	.4	345
Shoulder and clod:							
Edible portion	.....	68.9	20.0	10.3	.....	1.1	805
As purchased	17.4	57.0	16.5	8.4	.....	.9	660
Socket:							
Edible portion	.....	57.1	16.9	25.2	.....	1.0	1,380
As purchased	35.8	36.7	10.8	16.2	.....	.6	885
Forequarter, lean:							
Edible portion	.....	68.6	18.9	12.2	.....	.8	865
As purchased	22.3	53.3	14.7	9.5	.....	.6	675
Forequarter, medium fat:							
Edible portion	.....	60.4	17.9	21.4	.....	.9	1,235
As purchased	18.7	49.1	14.5	17.5	.....	.7	1,010
Forequarter:							
Edible portion	.....	62.5	18.3	18.9	.....	.9	1,135
As purchased	20.6	49.5	14.4	15.1	.....	.7	905
Hind quarter, lean:							
Edible portion	.....	66.3	20.0	13.4	.....	1.0	935
As purchased	16.6	55.3	16.7	11.2	.....	.8	785
Hind quarter, medium fat:							
Edible portion	.....	59.8	18.3	21.6	.....	.9	1,250
As purchased	15.7	50.4	15.4	18.3	.....	.7	1,060
Hind quarter:							
Edible portion	.....	62.2	19.3	18.3	.....	.9	1,130
As purchased	16.3	52.0	16.1	15.4	.....	.8	950
Sides:							
Edible portion	.....	62.2	18.8	18.8	.....	.9	1,145
As purchased	18.6	50.5	15.2	15.5	.....	.7	935
BEEF ORGANS.							
Brain, edible portion	.....	80.6	8.8	9.3	.....	1.1	555
Heart:							
Edible portion	.....	62.6	16.0	20.4	.....	1.0	1,160
As purchased	5.9	58.2	14.8	24.7	.....	.9	1,320
Kidney:							
Edible portion	.....	76.7	16.6	4.8	0.4	1.2	520
As purchased	19.9	63.1	13.7	1.9	.....	1.0	335
Beef liver:							
Edible portion	.....	71.2	20.4	4.5	1.7	1.6	605
As purchased	7.3	65.6	20.2	3.1	2.5	1.3	555
Sweetbreads, as purchased	.....	70.9	16.8	12.1	.....	1.6	825
Suet, as purchased	.....	13.7	4.7	81.8	.....	.3	3,540
Tongue:							
Edible portion	.....	70.8	18.9	9.2	.....	1.0	740
As purchased	26.5	51.8	14.1	6.7	.....	.8	545
BEEF, COOKED.							
Scraps, as purchased	.....	23.2	21.4	51.7	.....	3.5	2,580
Roast, as purchased	.....	48.2	22.3	28.6	.....	1.3	1,620
Pressed, as purchased	.....	44.1	23.6	27.7	.....	1.5	1,610
Round steak, fat removed, as purchased	.....	63.0	27.6	7.7	.....	1.8	840
Loin steak, tenderloin, broiled, edible portion	.....	54.8	23.5	20.4	.....	1.2	1,300
Sandwich meat, as purchased	.....	58.3	28.0	11.0	.....	2.8	985
BEEF, CANNED.							
Boiled beef, as purchased	.....	51.8	25.5	22.5	.....	1.3	1,425
Chili-con-carne, as purchased	.....	75.4	13.3	4.6	4.0	2.7	515
Collops, minced, as purchased	.....	72.3	17.8	6.8	1.1	1.9	640
Corned beef	.....	51.8	26.3	18.7	.....	4.0	1,280
Dried beef, as purchased	.....	44.8	39.2	5.4	.....	11.2	960
Kidneys, stewed, as purchased	.....	71.9	18.4	5.1	2.1	2.5	600
Luncheon beef, as purchased	.....	52.9	27.6	15.9	.....	4.8	1,185
Ox cheek, as purchased	.....	66.1	22.2	8.4	.....	3.2	765
Ox palates, as purchased	.....	71.4	17.8	10.0	.....	1.2	755
Ox tails:							
Edible portion	.....	67.9	26.3	6.3	.....	1.2	755
As purchased	29.7	47.7	18.5	4.5	.....	.8	535
Roast beef, as purchased	.....	58.9	25.9	14.8	.....	1.3	1,105
Tongue, ground, as purchased	.....	49.9	21.4	25.1	.....	4.0	1,455
Tongue, whole, as purchased	.....	51.3	19.5	23.2	.....	4.0	1,340
Tripe, as purchased	.....	74.6	16.8	8.5	.....	.5	670

Average chemical composition of different kinds of meat—Continued.

Food materials.	Refuse.	Water.	Protein (N × 6.25).	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
BEEF, CORNED AND PICKLED.							
Brisket:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Edible portion	.....	50.9	18.3	24.7	.....	5.7	1,385
As purchased	21.4	40.0	14.4	19.4	.....	4.5	1,085
Flank:							
Edible portion	.....	49.9	14.6	33.0	.....	2.9	1,665
As purchased	12.1	43.7	12.9	29.2	.....	2.6	1,470
Plate:							
Edible portion	.....	40.1	13.7	41.9	.....	4.7	2,025
As purchased	14.5	34.3	11.7	35.8	.....	4.0	1,730
Rump:							
Edible portion	.....	58.1	15.3	23.3	.....	3.3	1,270
As purchased	6.0	54.5	14.3	22.0	.....	3.1	1,195
Extra family beef:							
Edible portion	.....	37.0	12.3	47.2	.....	4.0	2,220
As purchased	10.4	33.1	11.1	42.3	.....	3.6	1,990
Mess beef, salted:							
Edible portion	.....	37.0	12.6	44.5	.....	6.5	2,110
As purchased	10.5	33.0	11.2	39.9	.....	5.9	1,890
Corned beef:							
Edible portion	.....	53.6	15.6	26.2	.....	4.9	1,395
As purchased	8.4	49.2	14.3	23.8	.....	4.6	1,271
Spiced beef, rolled, as purchased	.....	30.0	12.0	51.4	.....	6.8	2,390
Tongues, pickled:							
Edible portion	.....	62.3	12.8	20.5	.....	4.7	1,105
As purchased	6.0	58.9	11.9	19.2	.....	4.3	1,030
Tripe, as purchased	.....	86.5	11.7	1.2	0.2	.3	270
Dried, salted, and smoked:							
Edible portion	.....	54.3	30.0	6.5	.4	9.1	840
As purchased	4.7	53.7	26.4	6.9	.....	8.9	780
VEAL, FRESH.							
Breast, very lean:							
Edible portion	.....	73.2	23.1	2.5	.....	1.2	535
As purchased	46.8	38.9	12.3	1.3	.....	.7	285
Breast:							
Edible portion	.....	68.2	20.3	11.0	.....	1.0	840
As purchased	24.5	51.3	15.3	8.6	.....	.8	645
Chuck:							
Edible portion	.....	73.8	19.7	5.8	.....	1.0	610
As purchased	19.0	59.8	16.0	4.7	.....	.8	495
Flank, as purchased	.....	66.9	20.1	12.7	.....	1.0	910
Leg:							
Edible portion	.....	71.7	20.7	6.7	.....	1.1	670
As purchased	11.7	63.4	18.3	5.8	.....	1.0	585
Leg, cutlets:							
Edible portion	.....	70.7	20.3	7.7	.....	1.1	705
As purchased	3.4	68.3	20.1	7.5	.....	1.0	690
Loin:							
Edible portion	.....	69.5	19.9	10.0	.....	1.1	790
As purchased	18.9	56.3	16.1	8.2	.....	.9	645
Neck:							
Edible portion	.....	72.6	20.3	6.9	.....	1.0	670
As purchased	31.5	49.9	13.9	4.6	.....	.7	455
Rib:							
Edible portion	.....	69.8	20.2	9.4	.....	1.1	775
As purchased	25.0	52.3	15.2	7.1	.....	.8	580
Rump:							
Edible portion	.....	62.6	19.8	16.2	.....	1.1	1,050
As purchased	30.2	43.7	13.8	11.3	.....	.8	735
Shank, hind:							
Edible portion	.....	73.6	20.7	5.5	.....	1.0	615
As purchased	61.1	28.6	8.0	2.2	.....	.4	240
Shoulder, lean:							
Edible portion	.....	73.4	20.7	4.6	.....	1.3	580
As purchased	18.3	59.9	16.9	3.9	.....	1.0	480
Shoulder and flank, medium fat:							
Edible portion	.....	65.2	19.7	14.4	.....	1.1	975
As purchased	23.0	50.2	15.1	11.0	.....	.9	745
Forequarter:							
Edible portion	.....	71.7	20.0	8.0	.....	.9	710
As purchased	24.5	54.2	15.1	6.0	.....	.7	535
Hind quarter:							
Edible portion	.....	70.9	20.7	8.3	.....	1.0	735
As purchased	20.7	56.2	16.2	6.6	.....	.8	580
Side, with kidney, fat, and tallow:							
Edible portion	.....	71.3	20.2	8.1	.....	1.0	715
As purchased	22.6	55.2	15.6	6.3	.....	8	555

Average chemical composition of different kinds of meat—Continued.

Food materials.	Refuse.	Water.	Protein (N × 6.25).	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
VEAL, FRESH—continued.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Heart, as purchased	.....	73.2	16.8	9.6	.....	1.0	720
Kidneys, as purchased	.....	75.8	16.9	6.4	.....	1.3	585
Liver, as purchased	.....	73.0	19.0	5.3	.....	1.3	575
Lungs, as purchased	.....	76.8	17.1	5.0	.....	1.1	530
LAMB, FRESH.							
Breast or chuck:							
Edible portion	.....	56.2	19.1	23.6	.....	1.0	1,350
As purchased	19.1	45.5	15.4	19.1	.....	.8	1,090
Leg, hind:							
Edible portion	.....	58.6	18.6	22.6	.....	1.0	1,300
As purchased	13.8	50.3	16.0	19.7	.....	.9	1,130
Loin, without kidney and tallow:							
Edible portion	.....	53.1	18.7	28.3	.....	1.0	1,540
As purchased	14.8	45.3	16.0	24.1	.....	.8	1,315
Neck:							
Edible portion	.....	56.7	17.7	24.8	.....	1.0	1,375
As purchased	17.7	46.7	14.6	20.4	.....	.8	1,135
Shoulder:							
Edible portion	.....	51.8	18.1	29.7	.....	1.0	1,590
As purchased	20.3	41.3	14.4	23.6	.....	.8	1,265
Forequarter:							
Edible portion	.....	55.1	18.3	25.8	.....	1.0	1,430
As purchased	18.8	44.7	14.9	21.0	.....	.8	1,165
Hind quarter:							
Edible portion	.....	60.9	19.6	19.1	.....	1.0	1,170
As purchased	15.7	51.3	16.5	16.1	.....	.9	985
Side, without tallow:							
Edible portion	.....	58.2	17.6	23.1	.....	1.1	1,300
As purchased	19.3	47.0	14.1	18.7	.....	.8	1,055
LAMB, COOKED.							
Chops, broiled:							
Edible portion	.....	47.6	21.7	29.9	.....	1.3	1,665
As purchased	13.5	40.1	18.4	26.7	.....	1.2	1,470
Leg, roast	.....	67.1	19.7	12.7	.....	.8	900
Tongue, spiced and cooked:							
Edible portion	.....	67.4	13.9	17.8	.....	.5	1,010
As purchased	2.6	65.7	13.5	17.3	.....	.5	980
MUTTON, FRESH.							
Chuck, lean:							
Edible portion	.....	64.7	17.8	16.3	.....	.9	1,020
As purchased	19.5	52.1	14.3	13.1	.....	.8	820
Chuck:							
Edible portion	.....	48.2	14.6	36.8	.....	.8	1,825
As purchased	19.4	38.5	11.7	30.0	.....	.7	1,485
Flank:							
Edible portion	.....	42.7	14.3	42.6	.....	.7	2,065
As purchased	9.9	39.0	13.8	36.9	.....	.6	1,815
Leg, hind:							
Edible portion	.....	63.2	18.7	17.5	.....	1.0	1,085
As purchased	17.7	51.9	15.4	14.5	.....	.8	900
Loin, without kidney or tallow:							
Edible portion	.....	47.8	15.5	36.2	.....	.8	1,815
As purchased	14.8	40.4	13.1	31.5	.....	.6	1,575
Neck:							
Edible portion	.....	56.6	16.7	26.3	.....	1.0	1,420
As purchased	26.4	41.5	12.2	19.6	.....	.7	1,055
Shoulder:							
Edible portion	.....	60.2	17.5	21.8	.....	.9	1,245
As purchased	22.1	46.8	13.7	17.1	.....	.7	975
Forequarter:							
Edible portion	.....	52.9	15.6	30.9	.....	.9	1,595
As purchased	21.2	41.6	12.3	24.5	.....	.7	1,265
Hind quarter:							
Edible portion	.....	54.8	16.7	28.1	.....	.8	1,495
As purchased	17.2	45.4	13.8	23.2	.....	.7	1,235
Side, including tallow:							
Edible portion	.....	54.2	16.3	28.9	.....	.9	1,520
As purchased	18.1	45.4	13.0	23.1	.....	.7	1,215
Side, not including tallow:							
Edible portion	.....	53.6	16.2	29.8	.....	.8	1,560
As purchased	19.3	43.3	13.0	24.0	.....	.7	1,255
MUTTON, COOKED.							
Mutton, leg roast, edible portion	.....	50.9	25.0	22.6	.....	1.2	1,420

Average chemical composition of different kinds of meat—Continued.

Food materials.	Refuse.	Water.	Protein (N × 6.25).	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
MUTTON, ORGANS.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Heart, as purchased	.....	69.5	16.9	12.6	.....	.9	845
Kidneys, as purchased	.....	78.7	16.5	3.2	.....	1.3	440
Liver, as purchased	.....	61.2	23.1	9.0	5.0	1.7	905
MUTTON, CANNED.							
Corned, as purchased	.....	45.8	28.8	22.8	.....	4.2	1,500
Tongue, as purchased	.....	47.6	24.4	24.0	.....	4.8	1,465
PORK, FRESH.							
Chuck ribs and shoulder:							
Edible portion	.....	51.1	17.3	31.1	.....	.9	1,635
As purchased	18.1	41.8	14.1	25.5	.....	.8	1,340
Flank:							
Edible portion	.....	59.0	18.5	22.2	.....	1.0	1,280
As purchased	18.0	48.5	15.1	18.6	.....	.7	1,065
Ham, fresh:							
Edible portion	.....	50.1	15.7	33.4	.....	.9	1,700
As purchased	10.3	45.1	14.3	29.7	.....	.8	1,520
Head:							
Edible portion	.....	45.3	13.4	41.3	.....	.7	1,990
As purchased	68.4	13.8	4.1	13.8	.....	.2	660
Head cheese:							
Edible portion	.....	43.3	19.5	33.8	.....	3.3	1,790
As purchased	12.1	42.3	18.9	24.0	.....	3.0	1,365
Loin (chops):							
Edible portion	.....	50.7	16.4	32.0	.....	.9	1,655
As purchased	19.3	40.8	13.2	26.0	.....	.8	1,340
Loin, tenderloin, as purchased [a]	.....	66.5	18.9	13.0	.....	1.0	900
Middle cuts:							
Edible portion	.....	48.2	15.7	36.3	.....	.7	1,825
As purchased	19.7	38.6	12.7	28.9	.....	.7	1,455
Shoulder:							
Edible portion [b]	.....	51.2	13.3	34.2	.....	.8	1,690
As purchased	12.4	44.9	12.0	29.8	.....	.7	1,480
Side, lard and other fat included:							
Edible portion	.....	29.4	9.4	61.7	.....	.4	2,780
As purchased	11.2	26.1	8.3	54.8	.....	.4	2,465
Side, not including lard and kidney:							
Edible portion [c]	.....	34.4	9.1	55.3	.....	.5	2,505
As purchased	11.5	30.4	8.0	49.0	.....	.5	2,215
Clear backs:							
Edible portion [d]	.....	25.1	6.4	67.6	.....	.4	2,970
As purchased	5.7	23.7	6.0	63.8	.....	.4	2,805
Clear bellies:							
Edible portion [e]	.....	31.4	6.9	60.4	.....	.4	2,675
As purchased	6.2	29.5	6.5	56.6	.....	.4	2,510
Back fat, as purchased	.....	7.7	3.6	89.9	.....	.1	3,860
Belly fat, as purchased	.....	13.8	5.2	81.9	.....	.2	3,555
Ham fat, as purchased	.....	9.1	3.5	88.0	.....	.2	3,780
Jowl fat, as purchased	.....	16.0	5.9	78.8	.....	.2	3,435
Feet:							
Edible portion [f]	.....	55.4	15.8	26.3	.....	.8	1,405
As purchased	74.1	14.3	4.1	6.9	.....	.2	365
Tails:							
Edible portion [g]	.....	17.4	4.8	77.1	.....	.3	3,340
As purchased	13.3	15.0	4.1	66.9	.....	.3	2,900
Trimmings:							
Edible portion	.....	23.3	5.4	70.2	.....	.3	3,060
As purchased	7.4	21.6	5.0	65.0	.....	.3	2,835
PORK ORGANS, ETC.							
Brains, as purchased	.....	75.8	11.7	10.3	.....	1.6	655
Heart, as purchased	.....	75.6	17.1	6.3	.....	1.0	585
Kidneys, as purchased	.....	77.8	15.5	4.8	.....	1.2	490
Liver, as purchased	.....	71.4	21.3	4.5	1.4	1.4	615
Lungs, as purchased	.....	83.3	11.9	4.0	.....	.9	390
Marrow, as purchased	.....	14.6	2.3	81.2	.....	.....	3,470
Skin, as purchased	.....	46.3	26.4	22.7	.....	.6	1,450

[a] Eight samples contained an average of lecithin 0.51, gelatinoids 0.6, and "flesh bases" 0.9 per cent.
[b] Eight samples contained an average of lecithin 0.25, gelatinoids 0.8, and "flesh bases" 1.1 per cent.
[c] Eight samples contained an average of lecithin 0.35, gelatinoids 1, and "flesh bases" 1.5 per cent.
[d] Eight samples contained an average of lecithin 0.21, gelatinoids 0.6, and "flesh bases" 0.8 per cent.
[e] Eight samples contained an average of lecithin 0.18, gelatinoids 0.6, and "flesh bases" 0.9 per cent.
[f] Eight samples contained an average of lecithin 0.32, gelatinoids 3.5, and "flesh bases" 2 per cent.
[g] Eight samples contained an average of lecithin 0.20, gelatinoids 0.6, and "flesh bases" 0.6 per cent.

Average chemical composition of different kinds of meat—Continued.

Food materials.	Refuse.	Water.	Protein (N × 6.25).	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
PORK, PICKLED, SALTED, AND SMOKED.							
Ham, smoked:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Edible portion	.....	39.8	16.5	38.8	.....	4.7	1,945
As purchased	12.2	35.8	14.5	33.2	.....	4.2	1,670
Ham skin, as purchased	.....	27.2	15.4	53.7	.....	3.1	2,555
Ham, smoked, boiled, as purchased	.....	51.3	20.2	22.4	.....	6.1	1,320
Ham, smoked, fried, as purchased	.....	36.6	22.2	33.2	.....	5.8	1,815
Ham, boneless, raw:							
Edible portion	.....	50.1	14.9	28.5	.....	6.0	1,480
As purchased	[a]3.3	48.5	14.3	27.5	.....	5.8	1,425
Ham, luncheon, cooked:							
Edible portion	.....	49.2	22.5	21.0	.....	5.8	1,305
As purchased	[a]2.1	48.1	22.1	20.6	.....	5.7	1,280
Shoulder, smoked:							
Edible portion	.....	37.6	15.5	41.0	.....	6.1	2,020
As purchased	18.9	30.7	12.6	33.0	.....	5.0	1,625
Pigs' tongues, pickled:							
Edible portion	.....	58.6	17.7	19.8	.....	3.6	1,165
As purchased	3.2	56.8	17.1	19.1	.....	3.4	1,125
Pig's feet, pickled:							
Edible portion	.....	68.2	16.3	14.8	.....	.9	930
As purchased	35.5	44.6	10.2	9.3	.....	.6	585
Dry-salted backs:							
Edible portion	.....	17.3	7.7	72.7	.....	2.8	3,210
As purchased	8.1	15.9	7.1	66.8	.....	2.7	2,950
Dry-salted bellies:							
Edible portion	.....	17.7	8.4	72.2	.....	3.4	3,200
As purchased	8.2	16.2	7.7	66.2	.....	3.2	2,935
Salt pork, clear fat, as purchased	.....	7.9	1.9	86.2	.....	3.9	3,670
Salt pork, lean ends:							
Edible portion	.....	19.9	8.4	67.1	.....	5.7	2,985
As purchased	11.2	17.6	7.4	59.6	.....	5.1	2,655
Bacon, smoked:							
Edible portion	.....	20.2	10.5	64.8	.....	5.1	2,930
As purchased	8.7	18.4	9.5	59.4	.....	4.5	2,685
Ribs, cooked, as purchased	.....	33.6	24.8	37.6	.....	2.2	2,050
Steak, cooked, as purchased	.....	33.2	.....	45.4	.....	1.5	2,285
PORK, CANNED.							
Brawn, boars' brains, as purchased	.....	49.0	25.2	23.0	.....	4.6	1,440
Boars' heads, as purchased	.....	55.3	20.7	22.2	.....	3.3	1,320
Ham, deviled, as purchased	.....	44.1	19.0	34.1	.....	3.3	1,790
SAUSAGE.[b]							
Arles:							
Edible portion	.....	17.2	26.8	50.6	.....	7.3	2,635
As purchased	5.2	16.3	25.4	48.0	.....	6.9	2,495
Banquet:							
Edible portion	.....	62.7	18.3	15.7	.....	3.7	1,005
As purchased	1.6	61.7	18.0	15.4	.....	3.6	985
Bologna:							
Edible portion	.....	60.0	18.7	17.6	0.3	3.7	1,095
As purchased	3.3	55.2	18.2	19.7	.....	3.8	1,170
Farmer:							
Edible portion	.....	23.2	29.0	42.0	.....	7.6	2,310
As purchased	3.9	22.2	27.9	40.4	.....	7.3	2,225
Frankfort, as purchased	.....	57.2	19.6	18.6	1.1	3.4	1,170
Holsteiner:							
Edible portion	.....	25.6	29.4	37.3	3.4	4.3	2,220
As purchased	2.2	25.1	28.7	36.5	3.3	4.2	2,135
Lyon, pure ham:							
Edible portion	.....	32.5	32.3	27.2	.....	8.0	1,750
As purchased	10.0	29.2	29.1	24.5	.....	7.2	1,575
Pork, as purchased	.....	39.8	13.0	44.2	1.1	2.2	2,125
Pork sausage meat, as purchased	.....	46.2	17.4	32.5	.....	3.4	1,695
Pork and beef chopped together, as purchased	.....	55.4	19.4	24.1	.....	1.0	1,380
Salmi:							
Edible portion	.....	30.5	24.1	39.9	.....	7.0	2,130
As purchased	9.3	27.6	21.8	36.2	.....	6.4	1,935

[a] Refuse, case.

[b] In some cases the sum of the percentages of water, protein, fat, and ash in sausage does not make 100. In such cases the difference is estimated as carbohydrates. There are, however, no tests showing the presence of these, and it may be more nearly correct to give no value for carbohydrates.

Average chemical composition of different kinds of meat—Continued.

Food materials.	Refuse.	Water.	Protein (N × 6.25).	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
SAUSAGE—continued.							
Summer:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
Edible portion	.....	23.2	26.0	44.5	.....	7.7	2,360
As purchased	7.0	20.9	24.5	42.1	.....	7.0	2,230
Tongue, as purchased	.....	46.4	20.1	33.1	.....	3.2	1,770
Wienerwurst, as purchased	.....	43.9	28.0	22.1	1.6	4.4	1,485
SAUSAGE, CANNED.							
Beef, as purchased	.....	59.6	17.9	20.6	.....	2.0	1,200
Bologna, Italian, as purchased	.....	42.6	24.9	27.8	.....	6.4	1,635
Frankfort, as purchased	.....	72.7	14.9	9.9	.....	2.8	695
Oxford, as purchased	.....	28.9	9.9	58.5	0.6	2.1	2,665
Pork:							
Edible portion	.....	56.6	16.6	24.8	.....	2.0	1,355
As purchased	[a]12.6	49.5	14.5	21.6	.....	1.8	1,180
CHICKENS.							
Young:							
As purchased	18.8	55.5	17.8	7.2	.....	.9	765
Edible portion	.....	68.4	21.9	8.9	.....	1.1	945
Meat, not including giblets	.....	66.9	22.6	10.1	.....	1.1	1,000
Dark meat	.....	70.1	20.8	8.2	.....	1.2	850
Light meat	.....	70.3	21.9	7.4	.....	1.1	835
Giblets	.....	71.0	19.8	6.4	.....	1.3	810
Liver	.....	69.3	22.4	4.2	2.4	1.7	800
Heart	.....	72.0	20.7	5.5	.....	1.4	770
Gizzard	.....	72.5	24.7	1.4	.....	1.4	695
Broiler:							
As purchased	29.1	51.2	15.5	3.3	.....	.8	540
Edible portion	.....	69.7	20.7	8.3	.....	1.1	890
Meat, not including giblets	.....	69.2	21.1	8.8	.....	1.1	880
Giblets	.....	72.8	18.7	6.1	.....	1.3	730
Capon:							
As purchased	17.5	46.8	17.7	17.5	.....	1.0	1,205
Edible portion	.....	56.7	21.5	21.2	.....	1.2	1,465
Meat, not including giblets	.....	55.8	21.6	22.1	.....	1.2	1,460
Giblets	.....	63.3	20.5	14.6	.....	1.3	1,155
Other:							
As purchased	25.2	47.3	14.4	12.6	.....	.7	910
Edible portion	.....	59.5	20.4	19.2	.....	1.1	1,350
Meat, not including giblets	.....	63.4	19.4	16.6	.....	1.0	1,215
Giblets	.....	64.7	18.7	13.7	.....	1.3	1,070
OTHER FOWL.							
Turkey:							
As purchased	14.3	49.2	19.0	16.2	.....	1.0	1,185
Edible portion	.....	57.4	22.2	18.9	.....	1.2	1,385
Dark meat	.....	57.0	21.4	20.6	.....	1.1	1,435
Light meat	.....	63.9	25.7	9.4	.....	1.3	1,065
Giblets	.....	56.7	17.7	23.5	.....	1.2	1,480
Dark meat, cooked	.....	53.7	39.2	4.3	.....	2.2	1,200
Light meat, cooked	.....	58.5	34.6	4.9	.....	1.8	1,090
Young, as purchased	32.4	44.7	16.8	5.9	.....	.9	685
Young, edible portion	.....	66.1	24.9	8.7	.....	1.3	1,015
Cooked	.....	52.0	27.8	18.4	.....	1.2	1,505
Heart	.....	68.6	16.8	13.2	.....	1.0	1,000
Liver	.....	69.6	22.9	5.2	.6	1.7	820
Gizzard	.....	62.7	20.5	14.5	1.2	1.1	1,170
Duck:							
As purchased	15.9	51.4	15.4	16.0	.....	1.1	1,085
Edible portion	.....	61.1	18.3	19.0	.....	1.3	1,290
Meat, not including breast or giblets	.....	55.5	17.4	26.1	.....	1.0	1,540
Breast	.....	73.9	22.3	2.3	.....	1.3	685
Giblets	.....	73.2	17.9	5.0	.....	1.8	720
Duckling:							
As purchased	16.2	43.3	12.0	28.0	.....	.7	1,515
Edible portion	.....	51.7	14.3	33.4	.....	.9	1,805
Meat, not including giblets	.....	48.3	13.5	37.9	.....	.7	1,950
Giblets	.....	70.2	18.9	8.1	.....	1.6	835
Green goose:							
As purchased	12.2	41.9	13.6	31.6	.....	.8	1,710
Edible portion	.....	48.2	15.1	36.0	.....	.9	1,940
Meat, not including giblets	.....	46.0	15.0	38.3	.....	.8	2,030
Giblets	.....	68.7	22.3	7.3	.....	1.4	995

[a] Refuse liquid.

Average chemical composition of different kinds of meat—Continued.

Food materials.	Refuse.	Water.	Protein (N × 6.25).	Fat.	Total carbohydrates.	Ash.	Fuel value per pound.
OTHER FOWL—continued.							
Goose:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Cals.*
As purchased	11.1	48.0	14.8	25.5	.....	1.0	1,475
Edible portion	.....	54.0	16.6	28.7	.....	1.1	1,660
Meat, not including giblets	.....	51.8	16.2	31.5	.....	1.0	1,755
Giblets	.....	70.0	20.1	8.2	.....	1.7	910
Gizzard	.....	73.8	19.6	5.8	.....	1.0	750
Liver	.....	62.6	16.6	15.9	3.7	1.2	1,175
Pigeon:							
As purchased	13.6	55.2	19.7	9.5	.....	1.3	915
Edible portion	.....	64.0	22.8	11.0	.....	1.5	1,060
Meat, not including giblets	.....	63.2	22.9	12.1	.....	1.4	1,100
Giblets	.....	68.1	22.2	5.2	.....	2.3	845
Squabs:							
As purchased	15.6	49.0	15.7	18.6	.....	1.3	1,205
Edible portion	.....	58.0	18.6	22.1	.....	1.5	1,430
Meat, not including giblets	.....	56.6	18.5	23.8	.....	1.4	1,470
Giblets	.....	69.8	19.8	7.2	.....	2.0	835
Guinea hen:							
As purchased	16.4	57.7	19.4	5.4	.....	1.1	730
Edible portion	.....	69.1	23.1	6.5	.....	1.3	870
Meat, not including giblets	.....	68.9	23.4	6.5	.....	1.3	865
Giblets	.....	69.9	20.8	7.1	.....	1.3	855
Pheasant:							
As purchased	12.0	61.5	21.5	4.2	.....	1.0	730
Edible portion	.....	69.9	24.4	4.8	.....	1.1	830
Meat, not including giblets	.....	70.0	24.7	4.6	.....	1.1	815
Giblets	.....	68.9	20.1	7.2	.....	1.6	880
Russian pheasant:							
As purchased	14.1	61.1	21.5	1.9	.....	1.2	635
Edible portion	.....	71.1	25.0	2.3	.....	1.4	740
Meat, not including giblets	.....	70.6	25.7	2.3	.....	1.4	730
Giblets	.....	74.4	21.2	2.2	.....	1.3	665
Quail:							
As purchased	10.5	59.0	22.3	6.1	.....	1.4	835
Edible portion	.....	65.9	25.0	6.8	.....	1.6	935
Meat, not including giblets	.....	66.3	25.4	7.0	.....	1.4	945
Giblets	.....	63.0	21.8	6.2	.....	2.3	970
PRESERVED POULTRY MEAT.							
Smoked goose breast (including skin and fat)	.....	35.7	20.1	38.7	.....	5.5	2,210
Smoked goose breast (skin and outer fat removed)	.....	61.3	26.1	4.4	.....	8.0	845
Potted turkey	.....	56.0	17.2	22.0	.....	3.0	1,390
Potted chicken	.....	56.1	19.4	20.3	.....	2.5	1,390
Canned chicken soup	.....	87.1	2.9	3.3	5.1	1.6	300
Canned chicken gumbo soup	.....	91.0	2.4	.2	4.8	1.6	160
Canned boned chicken	.....	67.6	27.7	12.8	.....	2.2	1,245
Canned sandwich chicken	.....	46.9	20.8	30.0	.....	2.6	1,825
Canned sandwich turkey	.....	47.4	20.7	29.2	.....	2.7	1,790
Canned quail	.....	66.9	21.8	8.0	1.7	1.6	935
Terrine de foie gras	.....	41.3	13.6	38.2	4.3	2.6	2,075