Science for the Home*

Losses and Other Chemical Changes in Boiling Vegetables

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IN a former article "On Cooked Food" in *Knowledge* (1912, xxxv.) the author gave some account of her investigations into the chemical composition of cooked fish and vegetable foods. It was fully explained that the main object of the investigations was to arrive at a clear idea of the value of food as served at table, and the results showed that many false ideas exist as to the proportion of nutrients contained; full details were given as to the preparation of the articles selected and the part played by water in the process of cooking, and attention was directed to the fact that the percentage of water is one of the most important parts of food analysis; we want to know how much solid food we really consume. In meat and fish there is a higher percentage of solid matter, and the whole of the flesh consists of nutrients, fat, protein, and mineral matter. Vegetables, on the other hand, besides these nutrients, contain starch inclosed in cell walls of fiber or, as it is also called, cellulose. The latter substance has a doubtful value from the food point of view as a nutrient. Inside this framework is found the starch; in the process of cooking the starch granules are gelatinized and break down the cell walls, as can be seen in a well-cooked potato. The effect of cooking as regards solid matter is interesting, since after this operation the nutrients in the case of fish and meat show a higher percentage, whereas with vegetables the reverse is the case with a few exceptions. Only the edible portion is here considered—that is, the portion of vegetables that can be eaten as food. A simple definition of food is the one to be found in Dr. R. Hutchinson's "Food and the Principles of Dietetics": "anything which, when taken into the body, is capable of either repairing its waste or of furnishing it with material from which to produce heat or nervous and muscular work." The ordinary articles of diet are mixtures of various chemical substances, and among the most important of these are those containing nitrogen, examples of which are gluten in bread, legumin in pulses; but these are though different chemical substances and are classified under the general term protein. Non-nitrogenous is a term used for the carbohydrates, sugar, starch, also fats, such as butter. Another important group is called mineral matter (or ash), and here we have table-salt, also calcium specially found in asparagus and spinach, salts of iron also in spinach, peas and potatoes; finally, water, which forms a large part of even our most solid looking foods. In this article it is proposed mainly to deal with vegetable foods. As a rule, most vegetables are sold in a vague way as to price—by the bunch with carrots; spinach, however, is sold by the pound. Three samples were bought about the same time at twopence each per pound: (1) The waste was $4\frac{1}{2}$ ounces; (2) solid 1 pound 3 ounces; waste, 3 ounces; (3) the weight of the paper included was $\frac{1}{4}$ of an ounce, 7 ounces were waste (stems and roots), leaving only 8 $\frac{3}{4}$ ounces for cooking purposes. The next question is how much refuse is there when bought? This consists of the skins of potatoes. Here, it may be remarked, care should be taken in the peeling of potatoes, as the layer next the skin is considerably richer in mineral matter and protein than any other part of the flesh; if this is wasted then the starch mainly forms the portion served at table. The best method to cook this vegetable is in the skin. With green peas the pods are often looked on as waste; they form 45 per cent of the vegetable as sold, but can be used for soup provided some peas are added. A fact not generally known is that the pods are chopped up, boiled or steamed till the mass is soft; it is then crushed and passed through a sieve to separate the fiber from the edible portion; the latter is evaporated down, mixed with sugar, and sold as a kind of marmalade, or mixed with currants, gooseberries, or banana pulp and made into jam.

Two examples are given of the refuse in fish as sold, but it is often cleaned before leaving the shop, which is not usually the case with vegetables.

Before preparing the sample for cooking it was weighed, and then the refuse was weighed and percentage calculated; so now the remaining vegetable is weighed before and after the process of cooking, to determine the increase or decrease which is due to the loss or absorption of water. All waste is removed, such as the hard part of the stems of asparagus, bones and head of fish, shells of eggs. With one class of foods, the cereals, there is no refuse or waste; all is consumed as food.

All vegetables were simply boiled in water as supplied by the Bristol Water Company; this water is hard, due to the presence of calcium carbonate, but is otherwise excellent.

It will be seen some foods contain the two kinds of refuse, one the portion removed before cooking, the outer leaves of vegetables, the other the stems, bones of fish, etc., left after serving at table, and the asparagus is one example; this sample cost 9 $\frac{1}{2}$ d. per pound, only 31 $\frac{1}{4}$ per cent was fit for cooking, and of this 31 $\frac{1}{4}$ when cooked and served at table only 66 per cent could be eaten, making this vegetable an expensive article. A great deal of information has been published in America by the Department of Agriculture in Bulletins which are freely distributed in that country and can be bought by anyone for a few pence each; one in especial is valuable, No. 28 (Office of Experiment Stations), prepared by Prof. Atwater and A. P. Bryant, entitled "The Chemical Composition of American Food Materials;" it contains details of the analyses of 4,060 American articles and commodities used for human food in that country, but in most cases they are uncooked.

We must now pass on to the main question—what are the principal changes that take place in the process of

REFUSE FOR COOKING. (In 100 parts.)

Food	Refuse.
Endive	52
Green peas	45
Parsnips	7 $\frac{1}{2}$
Green artichokes	72 $\frac{1}{2}$
John Dory	21 $\frac{1}{2}$
Cucumber	15
Borecole	38
Carrots	23
Celeriac	7
Vegetable marrow	18
Leeks	75
Gurnet	9

cooking? The first point is the change in the percentage of water; we could not live on dry foods—that is, foods that contained no water; on the other hand, it is clear a high percentage results in a bulky food.

During the process of cooking meat and fish we have a decrease in weight. Prof. Grindley, of Illinois, has done a good deal of work on the subject of losses in the cooking of meat and the influence of cooking upon the nutritive value of meats. He found, besides losing water, some of the fat, protein, and mineral matters are dissolved out. He examined the extracts from boiling lean beef, and found as the average of 91 samples the loss of mineral matter was 41 $\frac{1}{2}$ per cent of the total amount present, of fat 12 per cent, and of protein 7 $\frac{1}{4}$ per cent. The same is true of fish. While nutrients are lost in the process, as is proved by the examination of the liquid after the meat is removed, a higher percentage of nutrients is found in the cooked condition and a lower percentage of

REFUSE AS SERVED AT TABLE. (In 100 parts.)

Sample	Refuse.
Asparagus	34
New potatoes	22 $\frac{1}{2}$
Green artichokes	69
John Dory	21
Herrings	12
Haddock	35

water. With vegetable food the reverse is true; as commonly cooked almost all vegetables show an increase in the percentage of water and a lower percentage of nutrients. The question arises: Is this waste necessary? That is, can it be prevented? In Bulletin 43, Office American Experiment Stations, Prof. Snyder describes the loss in boiling potatoes, cabbage, and carrots. He found with potatoes the greatest loss was when they were peeled and soaked in cold water before boiling, amounting to one quarter of the total protein present—"in a bushel of potatoes the loss would be equivalent to a pound of sirloin steak." Less loss is sustained if the peeled vegetable is at once plunged into boiling water, as then the proteins are coagulated on the surface and make the inner juices less liable to loss. When the potatoes are cooked in their skins the best results are obtained. The loss of mineral matter by the first method is as high as 38 per cent. As generally cooked an excess of water has to be drained off; this is often thrown away. Prof. Snyder remarks with carrots a good deal depends upon the size of the pieces into which they are cut for cooking, the loss being greatest with small pieces. Often about 1 pound of the sugar alone per bushel is removed, losing one quarter of the total nutrients. To get the best food value the pieces should be large and the boiling

rapid, and as little water as possible should be used. Cabbage in the raw condition only contains 7 $\frac{1}{2}$ pounds of solid in 100 pounds, and of this 2 $\frac{1}{2}$ to 3 pounds are lost in cooking. It is quite clear that such losses ought to be taken into account in drawing up dietaries. Further, such methods of cooking produce unpalatable dishes. Of losses found by the author in the course of her investigations spinach may be mentioned. In this case there are only 10 pounds of solid in 100 pounds of the vegetable; after cooking the loss is 2 $\frac{1}{4}$ pounds, about one fourth of the total solid. Celeriac 9 $\frac{1}{2}$ pounds of solid in 100 pounds of raw, and the average of three samples shows 4 $\frac{1}{2}$ pounds are lost. Curly greens or borecole 100 pounds contain only 10 $\frac{3}{8}$ pounds solid, and of this 5 $\frac{1}{4}$ pounds are lost, in both cases about one half of the solids. Turnips only contain about 9 pounds of solid per 100 pounds, and here the loss is nearly 4 pounds. In cooking lettuce we find 1 pound lost of the 4 pounds (or one fourth) solids in 100 pounds of the raw vegetable. With the large variety of asparagus matters are rather better, as of the 8 pounds solid only $\frac{1}{2}$ pound is lost per 100 pounds uncooked.

This, then, is the result of ordinary methods of cooking. Presumably the idea is that since vegetables are cheap it does not matter if nearly half their nutrients are thrown down the kitchen sink. Sir Henry Thompson, many years ago, drew attention to this waste in "Food and Feeding." The remedy he and others suggest is the use of the liquid in which vegetables are boiled for the foundation of soup, like the French peasant's "*pot-au-feu*." "To the pot of the peasant, who wastes nothing whatever, all things are welcome, and every atom of nutritive material—solid or liquid—goes into it, to which are always added herbs and vegetables, together with the liquor in which any of the latter may chance to have been boiled. Sometimes it is a *pot maitre*, no meat of any kind having been procurable, and very good vegetable soups, moreover, are educible therefrom."

Another method of cooking is coming to the front, and is called the "Conservative." Using this, vegetables are no longer merely washed-out stuff with all the goodness boiled and drained away and then pressed in a cloth. When the new method is employed as little water as possible is used, and that is absorbed or evaporates away. No draining or pressing is necessary, consequently there is no waste.

I have carried out some experiments recently to test the value of this process and found very satisfactory results. The first samples used were carrots and parsnips. In 1 pound about one twelfth of the total solid was lost, while more recently, with still more care in cooking green peas, celeriac, new potatoes, salsify, and turnips, the waste has been *nil*; all the water has been absorbed and the cooked vegetable has retained all its nutrients.

This series of vegetables was cooked in a Welbank's boilerette. These cookers are very simple in construction, and are practically a type of double saucepan. A certain amount of water is placed between the two vessels. The boilerette is then placed over the heating apparatus, and when steam comes through the valve the prepared vegetable can be put in the machine with half a tea-cupful of water. Some vegetables are better done when they are put into the basket which fits into the apparatus. Potatoes, for example, take rather longer cooking, but the process goes on by itself and does not need constant attention. Some cooks have used an ordinary saucepan for cooking spinach, with only the addition of just enough water to be absorbed, and in this method there was no loss of solids.

The two methods can be compared, and it is seen that to get the full value for the money spent the "Conservative" is the most economical. To return to the losses in cooking, it is interesting to know exactly which of the nutrients are lost and how the loss is ascertained. As soon as the process of cooking is finished the excess of water is drained off into an evaporating dish whose weight is known; heat is applied, and when only the solid is left the dish is again weighed and the percentage and weight of the loss is calculated. The solid is reduced to powder and analyzed. The result of analysis shows none of the fiber, fat, or starch is lost, but carbohydrates in the form of sugar are, as has been said in the case of carrots, and is also true with beetroots. The most important losses are protein and mineral matter; with potatoes, protein 25 per cent, of the total mineral matter 38; carrots, loss of protein 6 $\frac{1}{2}$ per cent. Here the carbohydrates being mainly sugar the loss is 25 per cent of mineral matters, 37 of the total present in each case.

The percentage per 1 pound of the following vegetables

shows the loss in the total solids: Celeriac, loss one half; of this, 7 per cent was mineral matter and 54 per cent protein; curly greens, two fifths of the total solid, 15¾ of this is mineral matter, 41 per cent protein. Chicory, one fifth of solid lost; of this 42½ per cent protein, 12 per cent ash. Butter-beans lost one tenth of the solids, of which 28¼ per cent was protein, 5½ per cent ash. Endive, total loss about one fourth of the solid; of this, 29½ per cent was protein, 18¾ per cent ash. These mineral matters are needed by the human body as tissue formers, and can supply the potassium, calcium, iron, phosphorus, and sulphur in an ordinary diet; calcium and phosphorus in milk, the latter also in carrots, turnips, potatoes, various varieties of beans and peas. Iron among other sources is found in the yolks of eggs, oatmeal, potatoes, spinach, and apples. Prof. Sherman, of the University of Columbia, in Bulletin 185, Office Experiment Stations, gives details as to the value of iron in food and the needs of the human body. He also goes into the question of calcium, magnesium, and phosphorus. In Bulletin 227 he, with the assistance of others, gives full details of their dietary studies, the desire being to solve the question, how much of these elements are needed in the human diet?

The next important question is as to the percentage of water. When cooked in an excess of water which is drained off, the cooked article contains more water than the uncooked. Cooked the conservative way in the boilerette the percentage sometimes varies, in the other method a lower percentage in the cooked vegetable is quite an exception.—

THE PERCENTAGE OF WATER IN THE RAW AND COOKED CONDITIONS.

Name.	Raw.	Cooked.	Cooked in Boilerette.
Scarlet runners.	93	94	
Beetroot.	82	83	
Endive.	91	95	
Parsnips.	76	81	79
Green peas.	70	87	73
Celeriac.	91	94	89
Jerusalem artichokes.	80	92	79
New potatoes.	81		83
Salsify.	82½	84	80

Two vegetables on this list are not as well known as they ought to be, the names are even unknown by green-grocers doing a fairly good business; salsify is one of them. The roots can be left in the ground until late in the season, and it comes into use as a variety in the winter. It is often called the oyster plant, because the flavor suggests that of oysters. The other vegetable is celeriac, which is also known as "knot celery" and "turnip rooted celery;" the roots only are eaten. It also comes into the market during the winter. Its flavor is something like celery.

In another class of vegetable foods the change in the percentage of water is still more marked; that is, the pulses. In dealing with these foods one of the most important factors to consider is the amount of protein present. We often see the statement that the pulses are rich in this nutrient, and for this reason they are called "poor man's beef." This is true only in the uncooked condition, but not as we eat them. This idea arises from the incorrect method of describing the results of analysis. In most tables the percentage of water is left out, and only those of fat, fiber, protein and carbohydrates are given, thus making these percentages appear higher than they really are; also the comparison is between meat and pulses in the uncooked state. Here we find for protein, beef 22, veal 20, mutton 20, lentils 22, peas (dried) 21. Now, in the process of cooking, meat has lost water; therefore, the percentages of fat and protein are higher in the cooked condition, while with the pulses the reverse is the case, so that all the percentages of the nutrients are lower: Beef (boiled), 34; veal (roasted), 29; lentils, 9; peas, 9; that is, the percentage of protein in the natural moist condition as served at table.

PERCENTAGE OF WATER.		
Name.	Uncooked.	Cooked.
Beef.	71	57
Veal.	71½	58
Mutton.	67	51
Lentils.	12	66
Peas, dried.	14	62

With cereals, such as oatmeal, we have no loss of nutrients; all the water used in cooking is absorbed. Starting with 10 pounds of each of the following articles we find provost barley and oats 60, frame-food 156½, plasmon arrowroot 113, rice (prepared by a conservative method) 36 pounds.

These, then, are the chief changes in cooking vegetable foods, and it cannot be satisfactory that so much of the valuable nutrients should be lost by bad methods of preparation. It may be said vegetables are cheap, but

the great object of cooking is to make food attractive and wholesome, and it is the salts which give the flavor. It is a pity the subject of the scientific value of food is not studied in this country in the same way that it is in America. Much can be learnt from the publications of the Department of Agriculture in that country.

The Use of Clay Products in Domestic Building Construction *

As yet the field of permanent building materials has hardly been touched. On account of the increased cost of using such materials in domestic architecture, many people have been influenced to use frame or wood construction instead. But the supply of lumber is gradually decreasing and the people are having to turn to clay and cement products instead. The ever present fire risk in frame construction has done much to influence public sentiment toward more permanent structures. Before the use of permanent building materials will become universal it will be necessary to develop a whole group of contractors who understand structural problems and how to estimate intelligently. Up to the present time the use of brick and tile in domestic architecture has been very limited, inasmuch as the increase in cost has put its use out of the reach of the man of moderate means.

Very artistic effects can be obtained by the use of brick and tile. In fact, very few people have any conception of the number of ways in which these materials can be combined. For example, we will assume the design of a small brick residence. We will consider for the time being the treatment of the exterior surfaces. The first problem that presents itself is the color scheme. If we assume that we are to use a light colored brick it would be necessary to decide upon the color of the mortar to be used and the width of the joints. There is nothing which adds or detracts more from the beauty of a brick wall than to have no contrast between the brick and mortar and not to have variety of texture in the brick surfaces. Texture in brick surfaces can be obtained by using light and dark shades of the same brick, for example, introducing here and there brick which have been burned somewhat darker than others. Another way is by choosing a mortar joint which will give a shadow, for example, some brick require a flush or smooth joint to bring out the character, while others look better with raked or sunken joints. The smooth surface brick generally look the best with deep cut joints, while wire cut brick or matt surfaced brick such as that made at Boone, Iowa, require smooth joints in which the mortar comes out flush with the face of the brick.

Another way in which artistic effects can be obtained is by varying the color of the mortar. For example, a dark red wire cut brick will generally look the best when white mortar is used. This will tend to add contrast to the wall and hence eliminate a monotonous color scheme.

If dark mortar is used this feature requires considerable skill in treatment and can only be satisfactorily tried by laying up a small panel of brick work and experimenting upon color effects, etc. By varying the width of mortar joints interest can be gained. In fact, many times the beauty of a particular kind of brick is entirely lost by making the joints too narrow. Sometimes a joint as wide as ¾ inch will add just the right note to the appearance of the wall. Many brick masons will say that such wide joints are not satisfactory, but such a condition is due generally to ignorance on their part. Laying up brick with the wide mortar joints is somewhat more expensive because it takes much longer and also requires more mortar, but generally a matter of a few dollars invested in such a case will more than pay for the expenditure. It is so much more satisfactory to have a good looking wall both from an artistic as well as from a structural standpoint. Again, different varieties of brick combined, make interesting wall treatments. For example, it is possible to use a dark red brick with a light buff brick, and when worked in panels and patterns gives a very artistic effect. Care must be taken however not to violate color harmony nor to sacrifice structural features by introducing too much ornamental brick work.

Hollow tile block offers many opportunities for use in building construction. To-day a large percentage of foundations for small residences are made with blocks laid in mortar. This material offers many opportunities and its greatest advantage lies in the air chambers within the blocks. Objection however has been made that unless the walls are properly laid up, the interior of the house is cold, due to the leakage of heat. I believe that it is a mistake to apply the coating of plaster to the tile directly, because of condensation of moisture on the surfaces of the walls, causing

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serious results to the interior decoration of the surfaces. The wall should be stripped and then lathed and plastered as in frame construction. The argument is made, however, that such a condition does not take place, but the author has seen many fine examples of condensation and can not recommend such a procedure. Hollow tile as a building material has many merits. For example, it is easily and rapidly laid up and is comparatively inexpensive in cost, and, exclusive of brick and concrete, is the best surface for the application of cement stucco. This is due to the fact that the coefficients of expansion of the two materials are nearly equal, and hence the elimination of cracks and surface defects.

Manufacturers of tile and brick are beginning to realize the necessity for making a product which does not require an exterior coating of cement. Very artistic effects can be gotten by using hard burned vitrified block for facing, just the same as with hard burned or wire cut brick. In fact, in some of the Eastern States many residences have been made of this material and very satisfactory results obtained. At first one is not accustomed to the large size of the blocks in comparison with brick sizes, but the time is coming when such materials will be more widely used than ever before. In fact, to-day in rural communities the agriculturist is building his barns of vitrified tile and getting excellent results. There is no reason why he should not build his house in the same manner. Variety in surface treatment can be obtained in exactly the same manner as with face brick. Joints can be pointed with colored mortar and varied in width if desired. To be sure, our carpenter friends do not approve of such materials because they decrease the amount of work for members of their trade, and so to-day, in getting estimates upon buildings of permanent construction, it is a very difficult problem to get satisfactory figures. The primary reason is that the mechanics are not familiar enough with the use of such products and, as of old, do not like to take a chance on such construction without being highly paid for the same. There is no reason why a house of tile construction can not be built for approximately the same cost as one of frame, and, in fact, the time is coming when such will be the case.

One of the best evidences of the necessity for permanent building construction is the enormous fire loss each year. In fact, there are certain fire prevention and fire protection organizations in this country which are doing everything possible to educate the public along these lines and one of the greatest steps that can be taken is to protect the isolated home against destruction.

For evidence of permanent building construction one has only to turn to European countries. There we find that the lowly peasant lives in the same house which was occupied by his ancestors many generations before, and to-day these houses are just as good as when originally built. The European has had to look to economy of construction in every form and he has been awake to the fact that it is better to build permanently than to build temporarily and have to repair and replace the same within a period of a few years. This condition is fostered by the scarcity of lumber and hence its increased cost.

With the increased manufacture of brick and clay products the American citizen has every opportunity to build better homes at less cost and greater permanence than ever before. It is to be hoped that more people will take advantage of fire resisting construction and use the same in every building. By so doing, the cities and towns of this State, and every other State, will become more beautiful and artistic. The structures will be more permanent and will be subjected to a minimum risk of destruction by the elements.

Highly Phosphorescent Calcium Sulphide

A RECENT issue of the *Comptes Rendus* contains an account by M. P. Brevet of his experiments on the production of highly phosphorescent calcium sulphide. One of the most active was made by heating precipitated chalk with thirty per cent of its weight of powdered stick sulphur in a closed crucible for an hour, then impregnating the cold product with a trace of bismuth (0.0001 per cent in the form of an alcoholic solution of basic bismuth nitrate), again heating the mixture for two hours longer at a dull-red heat, and then allowing the still closed crucible to cool slowly in the furnace. Products exhibiting less phosphorescence were made by impregnating the calcium sulphide with tungsten, molybdenum, or vanadium. The presence of sodium carbonate, or chloride, in the original mixture had either no effect or an injurious one on the phosphorescence, and impurities in these salts may have been the cause of the phosphorescence which Verneuil observed with such fused mixtures.