Dietetic Value of Vegetables.

Katie L. Forsyth.
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Chemical composition.
Digestibility.
Cookery.
Dietetic Value in Disease.
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  Constipation.
Dietetic value and composition of different vegetables.
  Cereals - Wheat, Oats, Barley, Rice and Corn.
  Pulses.
  Roots and Tubers.
  Potato, Onion and Radish.
Green Vegetables.
  Tomato, celery, lettuce, rhubarb and asparagus.
Introduction.

As civilization advances, and the composition and cookery of vegetables are known, there is a larger amount of them used in our daily food. The potato, now so widely used, and forming a part of our daily diet, was entirely unknown in the eastern continent previous to the discovery of America. The same is true of many of the other common vegetables. The vegetables contain all the proximate food principles that are found in the animal foods. Potatoes are rich in carbohydrates, beans in nitrogenous matter, and nuts in fats. They are important foods in account of being the chief source of the starches and sugars, and also of being a much cheaper food than animal food. Though they are not as highly flavored as many of the animal
foods, they have an advantage if not being liable to undergo putrefaction, and if seldom, if ever, producing disease. In large cities where fresh vegetables are scarce, there is a tendency for the laborers to use stimulants, and also the same among Chinese who use an abundance of tea. The sources of vegetable food are manifold; almost every part of plants furnish foods, though more especially the seeds, roots, and stems.

Classes.

Plants which furnish their seeds as food belong to the two great divisions—cereals and pulses. Hutchinson classes the vegetable foods in the following way:

Cereals eg: wheat, oats, etc.
Pulses eg: beans, peas, and lentiles
Roots and Tubers eg: potatoes, onions, etc.
Green vegetables eg: asparagus, cabbage, etc.
Fruits and Nuts, e.g., Apple - Walnut, etc.
Fungi and Algae, e.g., Mushrooms, Algae.
However we will only treat of vegetables found in the first four groups.

Chemical Composition.

The characteristic of vegetable food is its richness in carbohydrate or heat and energy producing principle. The sugar is found in a soluble form throughout the plant. The starch is composed of minute grains formed into layers. By experiment we know that the starch in vegetables is not at all dissolved by cold water. It is only by boiling water that the starch grains are broken and soluble starch formed. For man, raw starch is almost useless material. In almost all of the vegetable foods, the starch is contained in numerous divisions, commonly called cells. The walls of these cells, and their general structure, are
composed of a substance known as cellulose. The cellulose is a form of carbohydrate, but it is characterized by its insolubility. Water, either cold or hot, will not have any effect upon it. The knowledge of the presence of this substance in almost all vegetables, is of great importance, for when we consider how the starch grains are surrounded by it and its insolubility, it is evident that this cellulose must present a resistance to the penetration of the nutritive substances by the digestive juices. The proteide in the vegetable foods contain more nitrogen and less of carbon, than the proteide of the animal foods. These proteides easily dissolve in water containing a little salt. The proteide of both the kingdoms have a similar composition, and serve the same purpose in the body, and act in a like
manner in the presence of heat or bacteria.

The fats much resemble those of the animal kingdom, though as a rule, they contain more of the oily constituents, and less of the solid material than do the animal, and produce fatty acids more slowly, thus remaining in good condition longer.

There is a very large amount of water present in vegetables. The vegetables which are the richest in solid constituents, contain seventy-eight percent of water, while many of the green vegetables, as the tomato and asparagus, contain over ninety percent. On account of this large percent of water, a large amount of vegetable food must be taken in order to gain enough nutriment. This large bulk of food often proves disadvantageous.

Many of the vegetables are rich in the mineral salts—the potato contains
nine tenths percent mineral matter, lettuce one percent, and asparagus contains nine tenths percent. It is necessary that the salt be supplied in our food as the different minerals are found in all of the different tissues. We know that the salt of lime is essential to the body as there is no tissue which does not contain it. Wheat contains one and nine tenths mineral matter of which a large percent is lime. Phosphate of potassium and sodium are important as the alkaline reaction of the blood plasma, i.e. partly due to them; these are found in the potato.

Digestibility.

On account of the large amount of starch that vegetables contain, they are not much acted on by the digestive secretions until reaching the intestines.
As a rule, vegetable foods are less easily digested and absorbed than the animal foods, though this depends upon the kinds of vegetable material. If the quantity is small, finely divided, and there is not much cellulose, there will be complete digestion and absorption. As in the case of bread, which is mainly a vegetable food, there is almost complete digestion and absorption.

Cookery.

In cooking vegetables the main objects to be gained is the softening and rupturing of the cellulose framework, and the gelatinization of the starch grains. When starch grains are exposed to heat and moisture, they burst and form a paste or jelly. As this jelly expands it presses on, and finally bursts the framework of the cellulose in which
the germ are enclosed. It is evident from the two above points that cooking is of great importance in rendering them digestible. The more cellulose there is, the more necessary is thorough cooking. The proteids of vegetables are congelated by heat, the same as are the meats. If a vegetable only contained proteids, the digestibility would be effected like the meats; that is, would be rendered more difficult of digestion by long cooking. But there is scarcely any vegetable food that does not contain a large percent of starch, so that the general rule of thorough cooking increases the digestibility of vegetables. When cooking vegetables great care must be taken that the mineral salts are not dissolved out. When both proteids and starches are present, perfect cooking may be attained by long cooking at low
temperature, while starch grains rupture most readily at 212°F, they will rupture at a much lower temperature if heat is long continued.

Dietetic value in Disease.

The salts—lactates, tartrates, acetates, and citrates become changed into carbonates within the body, and produce in the system that alkalinity which appears to be necessary to a state of normal nutrition, when developed in its highest form, we call scurvy. Always expect when there is an absence of these salts in the foods.

Organic acids are united with a number of the bases that are in the mineral ingredients, and when these acids are used up within the body, alkaline salts are produced. In the potato much of the potash is united with the citric acid. Sodium carbonate, and bicarbonate are
found in the blood plasma; these are
ingested in small quantities by vegetable
food, and are also formed in the body
from the decomposition of the salte of the
vegetable acids. These serve a useful
purpose in the blood by carrying the
carbonic acid from the tissues to the
lungs. The vegetable acids, when changed
into alkaline salts, act as preventives of gout.

The common disease, gout, may be chemi-

cally defined as a disturbance of the ni-

trogenous equilibrium by the retention or
accumulation of uric acid, which under
a sudden excess becomes precipitated as urate
in the different tissues. With the presence of fats
or carbohydrates in the food, the proteid metabolism
is checked, and a nitrogenous equilibrium
is established with a less amount of proteid food.
One of the effects of animal food is to provoke a
condition of acidity of the urine when the use of
vegetables render it alkaline. The ordinary reaction of human urine is acid, and it is customary to call this the normal reaction, because it is that which is usually the case of those that feed on a mixed diet. But the reaction becomes neutral or alkaline when animal food is not eaten, and with the acidity disappear also the concretions. The potash of the calcium, existing with the organic acids, is separated from the acids by organic combination, and is thus presented to the lithic acid of the blood and tissues, the strong particles of which it converts into soluble lithate of potash, and thus enables them to be carried out of the system. Uric acid in excess produces such diseases as gout and rheumatism. This uric acid results from the imperfect combustion of the nitrogenous matters for these being incompletely oxidized from uric acid instead of the urea which would be normally produced. The excess of nitrogenous food cause
not only an abnormal production of the
poisonous alkaloid, but it accumulates in
the blood and interferes with the oxidation, and
the liver, kidneys, and other excretory organs
are overtaxed in their work of eliminating waste
substances.

In cases of constipation vegetable foods prove
beneficial on account of producing peristaltic action.
All the foods that are rich in cellulose produce
peristalsis by their mechanical action. Foods
useful to produce this action would be oatmeal,
green vegetables, and whole meal bread. Peristalsis
is also produced by chemical action, and this is
brought about by the organic acids in the food.

Dietetic value and composition of cereals.

The cereals are really grasses which
by special cultivation have developed a large amount
of food material. They have been cultivated from
remote antiquity. They rank first in importance
amongst vegetable alimentary principles.
They are plentifully yielded and of easy digestion as the cellulose is not abundant except in outer covering. They have high nutritive value. The cereals are rich in nitrogenous substances, also in starch, and contain small and varying amounts of gum, sugar, and fat. They contain a considerable proportion of mineral substances, chiefly in the form of phosphates of lime, magnesium, potash, and sodium with smaller amounts of iron and silica.

Wheat is the main cereal, as it is the one that the common bread is made of. It is nutritious and is easily digested. There is a substance found in the grain called creatine, which is a form of diastase which helps to render the starch self digestible.

Composition of Wheat:

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Water</td>
<td>12</td>
</tr>
<tr>
<td>Protein</td>
<td>1</td>
</tr>
<tr>
<td>Fat</td>
<td>1.7</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>71.2</td>
</tr>
<tr>
<td>Cellulose</td>
<td>2.2</td>
</tr>
<tr>
<td>Mineral</td>
<td>1.9</td>
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Oats are regarded as being more nutritious than the other cereals. They contain a large percentage of iron and nitrogen. By experiments, oats have been found to contain a particular excitant principle. This power of being a strengthening and an excitant food renders oatmeal a suitable food for the dietary of children.

Composition of Oats.

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<table>
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<tbody>
<tr>
<td>Water</td>
<td>6.9</td>
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<tr>
<td>Protein</td>
<td>13</td>
</tr>
<tr>
<td>Fat</td>
<td>8.1</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>68.6</td>
</tr>
<tr>
<td>Cellulose</td>
<td>1.3</td>
</tr>
<tr>
<td>Mineral</td>
<td>2.1</td>
</tr>
</tbody>
</table>

For invalids, especially those suffering from gastric catarrh or other stomach troubles, no more nourishing food can be given than oatmeal jelly.

Rice is a cereal that is rich in starch but rather poor in fat and protein. The starch is present in small and easily digested grains. Rice is absorbed with great completeness in the
intestines. Practically none of the starch is lost. It is a food that leaves only a small residue in the intestines, and thus is an important food in certain cases of disease. As it contains easily digested starch grains, it is found a useful food in disordered states of the digestive tract. In persons suffering from diarrhea or dysentery, it agrees better than any other solid food, as it produces no laxative action.

Composition of Rice:

- Water 12
- Carbohydrate 76.8
- Protein 7.2
- Cellulose 1
- Fat 2
- Mineral 1

Barley is considered as a nutritious food being rich in nitrogenous substances. Especially is it rich in iron and phosphoric acid. Barley water is one of the main diets in many sick rooms, though it does not contain much nutrient, it is used for its demulcent properties. In almost all diseases nourishing
gruels are made from the cereals.

Composition of Barley:

Water 12.3  Carbohydrate 62.3
Protein 10.1  Cellulose 3.8
Fat 1.9  Mineral 2.4

Corn is a nutritious grain for it contains
a large proportion of fatty matter. Fresh sweet
corn is a valuable food; it contains a
small amount of arginine acid, and also
a valuable amount of nutrient. When fresh
it does not disagree with anyone.

Composition of corn:

Water 12.5  Carbohydrate 68.7
Protein 7.7  Cellulose 2.1
Fat 3.4  Mineral 1.3

Pulses.

The great group of vegetables known as
pulses, of which beans, peas, and lentils are the
chief foods, are valuable for the amount of
nitrogen they contain. They serve as a great
source of protein food. Some of the legumes, as the beans, are rich in sulphure, and they all contain potash and lime. They contain more lime than any other vegetable food. The pulsees are not readily digested by the stomach on account of their bulkiness when cooked. Though if they are properly cooked they will be almost completely absorbed in the intestines.

Roots and Tubers.

The chief food principle found in this class of foods is the carbohydrate. Protein and fat are scarcely represented at all. But they do contain mineral ingredients, mainly as salts of potash. These salts form their chief value. These should be cooked carefully as their mineral salts are likely to be lost. They should be cooked by means of steam as far as possible.

The potato is a very common and
useful food.

Composition of Potatoes:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Water</td>
<td>75.77</td>
</tr>
<tr>
<td>Starch</td>
<td>20.36</td>
</tr>
<tr>
<td>Nitrogenous Matter</td>
<td>1.77</td>
</tr>
<tr>
<td>Cellulose</td>
<td>7.5</td>
</tr>
<tr>
<td>Fat</td>
<td>1.6</td>
</tr>
<tr>
<td>Ash</td>
<td>0.97</td>
</tr>
</tbody>
</table>

Of the total amount of nitrogen only 47.70 is 
protein; the rest is ammonia compounds 
and salt. The starch grain is especially large 
and is easily attacked by ferments. Within 
and surrounding the cells is a fluid, the 
albuminous constituents of which are coagulated 
during cooking. The watery part of this juice 
is absorbed by the starch granules, which 
swell up and enlarge the cells in which they 
are contained. Unless the potato is properly 
cooked, the fluid referred to is only partially 
absorbed, and the cells do not become sufficiently 
distended. In this condition it is not digested 
and would not furnish to the system the anti 
ascorbic principle. Asparagin is one of the
chief forms of nitrogen. It is believed that this substance
limits putrefaction in the stomach, and thus shares the
proteides. The potato juice has a faintly acid reaction, this
is caused by the citric acid. It is combined with
salts of potassium, calcium, and sodium
which causes it to have value as an anti-
septic.

The onion is a valuable vegetable,
being rich in alkaline elements.

Composition of onion.

Water 85.99  Sugar 2.78

Nitrogenous Matter 1.86  Other extractives 8.84

Fat 1  Cellulose .71

The onion has a laxative power which is
believed to be due to its cellulose. It is a good
vegetable to use in cases of nervous diseases.

There is no vegetable that will relieve and
tone up a vomit system better than
the onion. It is used for coughs, and colds.
The onion is used as a blood purifier, as it stimulates all the secretions.

Radishes when young are used in salads for the sake of their acid and for their antiscorbutic property. They have a stimulating effect upon the urinary organs, and act as demulcents. They are often given in cases of cataract of stomach and bladder; but they prove difficult of digestion for many people.

Composition of Radishes:

Water 90.8  Carbohydrate 4.6
Nitrogenous Matter 1.4  Mineral 0.7
Fat 0.1  Cellulose 3.3
Extractives 1.1

Green Vegetables.

Green vegetables are valued mainly for their antiscorbutic salts and their flavor. The large proportion of cellulose among the solids makes them indigestible, but also useful as laxatives.
The tomato is a beneficial vegetable. It has a refreshing taste, and contains much malic acid which is beneficial to the system. The tomato produces laxative effects, and is very easily digested. The oxalic acid which it contains makes it injurious to use in cases of gout, or any disease where there is an abundance of uric acid. Tomatoes contain a small percent of salmol, and thus would be of benefit in conditions of the system in which the use of salmol is indicated.

Nitrogenous Matter 1.3  Carbohydrate 3.1  
Water 91.7  Mineral 0.7  
Fat 0.2  Cellulose 1.1

Celery is a vegetable that is useful in nervous diseases. When cooked it tends to be a very easily digested vegetable.

Composition of Celery. 
Water 94.6  Fat 0.7  Cellulose 1.1  
N. Matter 0.7  Carbohydrate 0.3  Mineral 0.6
Lettuce is a salad vegetable. The salads are useful, as none of the salts of the vegetable are lost. Lettuce is refreshing and cooling to the system. The juice of lettuce has a mild narcotic effect, similar to that of opium. It is easily digested and has laxative and antiscorbutic properties.

Water 94.1  Carbohydrate 2.6

N. matter 1.4  Mineral 1.

Fat .4  Cellulose .5

Rhubarb is an excellent vegetable. If thoroughly cooked, it is soft and digestible. It has laxative properties. Rhubarb must be avoided in gout and rheumatism on account of the oxalic acid it contains. Rhubarb, by the reason of the tannin it contains, has astringent power. It is a wholesome vegetable and has not received attention due it.

Composition of Rhubarb.
Water  94.6  Carbohydrate  2.3  
Nitrogenous matter  .7  Cellulose  1.1  
Fat  .7  Mineral  .6  

Asparagus is one of the green vegetables that has only slight nutritive value, but it contains a crystalline nitrogenous substance called asparagin, which produces marked physiological effects. It is sometimes used as a cardiac sedative, though it is best known as a diuretic. On this latter account, asparagus is often used as a solvent for urinary calculi.

Composition of Asparagus.

Water  91.7  Carbohydrate  2.7  
Nitrogenous matter  2.2  Mineral  .7  
Fat  .2  Cellulose  .2 1

Thus we see the hygienic and dietetic value of vegetables. From the economical standpoint they are the cheapest source of foods, not only of carbohydrates, but also of fat and protein. But their main value is the dietetic
value of their salts and acids, which act as a protection to the system against many common ailments.

Authorities:
Hutchinson — Food and Dietetics.
Thompson — Dietetics.
Knight — Food and Its Functions
Smith — Foods.

Dietetic and Hygienic Gazette.
Yeom — Food in Health and Disease.
Harrington — Practical Hygiene.
Winthrop — Vegetable Acids
Bulletin
Good Housekeeping.
Chloride Accumulator

1. Charge Curve
2. Discharge Curve
First Charge and Discharge

Sheet 1

Ampere Hours

1 2 3 4 5 6 7 8 9 10 11 12