

composition with cellulose, and it is second to it in quantity in the vegetable kingdom. If boiled with dilute acid it is converted into grape sugar.

CRUDE FAT.—If dry vegetable substances are washed with ether, the ether will extract therefrom the vegetable oils and fats, and also small quantities of waxlike substances and coloring matter. These oils, fats, waxlike substances and coloring matter are not easily (if at all) separable from one another, and are all included under the term "crude fat."

Fiber or cellulose, starch, sugar, gums and fat are all composed of hydrogen, oxygen and carbon, and are known collectively as carbohydrates. Just as the albuminoids are the muscle producers, so these non-nitrogenous substances are heat-producers. Their consumption supplies the animal body with warmth.

The digestible fiber, starch, sugar, gums are all regarded of equal value as heat producers. The digestible fat, on the other hand, is regarded as having $2\frac{1}{2}$ times the heat-producing capacity of the foregoing pound for pound. Digestible fat, therefore, is $2\frac{1}{2}$ times as valuable, pound for pound, as the other heat-producers.

NUTRITIVE RATIO.—The quantity of digestible albuminoids in a feeding-stuff as compared with the quantity of digestible heat-producers is known as the nutritive ratio. Average meadow hay has the following composition:

Water.....	14.3	per cent.		
Ash.....	6.2	"		
Protein.....	9.7	"	digestible	5.4, or 56 per cent. of the whole.
Crude fibre.....	26.3	"	"	15.0, or 57 " " "
Nitrogen-free extract.....	41.0	"	"	25.8, or 63 " " "
Crude fat.....	2.5	"	"	1.2, or 48 " " "

Multiply the digestible fat by $2\frac{1}{2}$, and we get 3. Now add 3, the digestible fiber 15, and the digestible nitrogen-free extract 25.8, and we get 43.8. The nutritive ratio of average meadow hay is, therefore, as 5.4 to 43.8, or as 1 to 8.1.

The following is the nutritive ratio of some common feeding stuffs:

Potatoes	1 to 12	Wheat bran	1 to 4
Turnips	1 " 8	Corn meal	1 " 10
Oats	1 " 6	Cottonseed meal	1 " $1\frac{1}{2}$
Maize	1 " 9	Wheat straw	1 " 69
Cow peas	1 " 3	Oat straw	1 " 28
Brewer's grain (dry)	1 " $3\frac{1}{2}$	Pea straw	1 " 4

The meaning of this is that potatoes contain 12 times, cow peas 3 times, wheat straw 69 times as much heat-producing as muscle producing substance. Cow peas have a narrow nutritive ratio, that is are rich in protein. The reverse is true of potatoes and wheat straw, which have a wide nutritive ratio.

It is manifest that an animal should be supplied daily with food in such quantity, and containing the heat-producers and muscle-producers in such proportions as to compensate for the daily wear, tear and drain upon its system. And if the feeding is to be economical, it should be so conducted that there be no unnecessary consumption