HUMAN FOODS
AND
BALANCED RATIONS

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Human Foods and Balanced Rations.*

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We are made out of carbon, oxygen hydrogen, nitrogen, principally, with a little iron, phosphorus, copper, sodium, potassium, calcium, etc. All these things are found in our foods, necessarily, for we are made out of food. But we cannot take pure carbon, nitrogen or hydrogen, and make anything much of it in the body, although we can use oxygen in its uncombined state as air. Almost all these things must be combined and prepared for us by plants taking them into their bodies before we can use them in ours (although we can also get them second-hand from animals). True, we cannot take a stalk of celery or a potato and replace a nerve or muscle with it. We must first break down the foods as we receive them, part way to their elements, using then, so to speak, the fragments to build up again into our bodies.

But besides building up our bodies, we use much of the food for fuel, to produce the immense heat we use to drive our body-engines. We have no individual furnace, with boilers over it and piston-rods connected, driving wheels or dynamos; we are, all over, furnace and boiler and machinery in every part, so small, so fitted into each other, so compact, and so dependent on delicate chemical and electrical reactions, that it has taken the life study of very many men to find out even what we know—a small percentage of the total facts. Fortunately, we are able to live, and probably have lived for many a thousand years without knowing the final details. If we had to know all about food, and what becomes of it in the body before we took a meal, the whole race would have stopped with its first ancestor, a day or two after he was born! However, some of the things we have found out seem to be more or less useful as general guides, and one of these deals with the value of different foods in a rather practical way, if you put a good deal of thought and care upon it.

It has been found, for instance, that a pound of coal will yield, when completely burned, just so much heat, varying with the kind and quality of coal, but always the same for the same kind and quality. It is true we may not burn it completely in our furnaces or stoves; we may waste the heat we do get from it, letting most of it go up the chimney; or we may use the heat we do use for very trivial purposes. But so much carbon, the principal constituent in coal, always can yield just so much heat, whether we waste it or not. Just so with different foods. If we take a turnip, or a pound of meat and burn it carefully as we would burn a pound of coal in testing it, we find a certain amount of heat produced—far less than a pound of coal would produce, of course, but exactly the same otherwise. Turnips and meat would make poor fuel for a stove or furnace, because there is so much water in them, but once they are dried out, the rest of them burns well, as we find in garbage incinerators. Now, very careful and elaborate experiments have shown that when meat or turnip is taken into the body and burned, the exact amount of heat it would have yielded if completely burned in a stove or furnace is yielded in the body, less about ten-per-cent. wastage that can be perfectly accounted for. Knowing this, it is not hard to understand that long series of experiments have determined for nearly every kind of food the exact fuel value, and this forms a very fair way of classifying the relative values of these foods to the body. It is not a perfect way however; the fuel value of coal is very high indeed, but since we cannot eat coal, that fact

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does not help us. The fuel value of wood is high, too, but although some animals can use wood for fuel in their bodies, we humans can't, so the fuel value of wood is no use to us. So also with grass and hay. Cows and horses can use those, but we can't. We have to find out by experience what things we can eat first, but once we know that, then knowing the fuel values of these different things also allows us to compare them pretty well. It must not be supposed that fuel value is the whole thing, however. Certain foods, especially vegetables, contain substances in very small amounts, a dram or less to the ton, which cut no figure at all as fuel, yet are so important to the body that disease and death result if they are not present. These are called vitamins. Their absence results in a disease called beri-beri, and scurvy is probably due to a similar lack.

Finally, as stated in a previous article, the fuel value of fat is more than double that of either of the other great foods, carbohydrate and protein, but we would die in time on a diet of fat alone—so also on a diet of carbohydrate alone. Protein * would keep life in us, all alone, but we would not get on as well as on a mixed diet.

DAILY FOOD FUEL REQUIRED BY AN ADULT MAN.

	grams		ounces		would boil water		calories
Protein	125 grams	=	4.4 oz.	=	5 quarts	=	512.5
Fat	75 grams	=	2.6 oz.	=	7 quarts	=	697.5
Carbohydrate	500 grams	=	17.6 oz.	=	20.5 quarts	=	2050.0
	700		24.6		32.5		3260.0

CALCULATING FUEL VALUES.

As previously explained, many of the different animal and vegetable foods that we eat, contain, in a crude state, some two or all three of the main things, protein, fat, carbohydrate: and they contain them in different proportions. Instead of laboriously testing the fuel value of every individual food, it is much easier and better to know the fuel value of protein, of fat, and of carbohydrate. Then we can, by simply analyzing the food, calculate the fuel value without further trouble.

Heat enough to raise the temperature of one litre of water one degree centigrade, is called a calorie. About one pound of protein, completely burned, would yield heat enough in burning to boil about four and a half gallons of water (about three and a half imperial gallons) that was just at the freezing point when the heat was first applied to it. (In actual tests, protein burned yields more heat than this, but in the body it is not all used for fuel, but partly to replace worn-out tissues, so that in the body it produces the heat above described.)

Carbohydrates have the same heat value in the body that the proteins have: but the fats have over twice the heat value, i. e., would boil twice as much water; a pound of lard, for instance, completely burned, would bring to boil about ten gallons of freezing water (about eight imperial gallons).

Now, the body requires varying amounts of fuel, depending on age, sex, height, weight, amount of work done, and many other things. Thus a young infant needs perhaps an average of 100 calories a day, i. e., enough food-fuel heat to bring to boil a quart of freezing-cold water. An active adult man, doing hard, muscular work, will need from 3,000 to 4,000 calories, or even more—enough to bring to boil eight or ten gallons of freezing-cold water.

Now, theoretically, a man could get the 3,000 to 4,000 calories he needs from a pound of lard, but fancy feeding a man a pound of lard a day, and nothing else! Moreover, he would starve to death on it, despite its fuel value, for pure lard contains no protein, i. e., no muscle or other tissue builder. Theoretically, also, a man would get the heat he needed from about two and a quarter pounds of granulated sugar, but again he would soon give out for lack of protein, even if he could manage to "down" pure sugar three times a day as his only food. Theoretically, also, two and a quarter pounds of protein would do him, with nothing else.

It is true he would not starve to death on this, but he would miss the quick-burning fats and sugars, and would not "feel right" or healthy or happy. The proportions of each form of food, then, is important. One might say, if we need all three kinds, why not just divide the total calories we need by three, and eat protein enough to supply one-third, fat enough to supply one-third, and carbohydrates enough to supply one-third? Doubtless this would make a tolerable diet, but experience and experiment go to show that an average adult man doing reasonably hard work, gets along

*The protein of maize is an exception. It lacks certain constituents that other proteins have.

best on about the following amounts in the following proportions:

Thus, each of the three meals should average about:

Protein	1½ oz.	=	170 calories
Fat	⅞ oz.	=	230 calories
Carbohydrate	6 oz.	=	700 calories
	8⅜		1100

So much is clear; but now comes the real difficulty. We do not have protein in one can, fat in another, carbohydrate in another, in such shape that people will eat and enjoy them, day after day. We must carefully select such commonplaces as meat, potatoes, bread, fruit, etc., so that the total eaten will represent these things, in the proper proportions, and giving after all a very commonplace appearance on the table.

To show how it is done, an illustration is given here, together with the necessary tables for a number of the ordinary foods.

EXAMPLE OF BALANCED RATION.

"Meat and Potatoes and Bread."

Desired for one average meal:—

Protein	42 grams	=	1½ oz.
Fat	25 grams	=	⅞ oz.
Carbohydrate	170 grams	=	6 oz.

CONSTITUENTS.

	Protein %	Fat %	Carbohydrate %
Lamb Chop	17.6	28.3	0.0
Potato	2.2	0.1	18.0
White Bread	9.2	1.3	53.1

Evidently all three supply protein, while the potatoes and bread supply the carbohydrate, and the chop supplies the fat chiefly.

If we are to have no waste, we must calculate the chop on the basis of the fat, thus 7/25 (28. per cent.) of the chop is fat; ⅞ of 1 ounce of fat we require in the meal; hence we need chop enough so that 7/25 of it will weigh ⅞ of an ounce; that is, the whole chop should weigh 25/7 of ⅞; equals 3⅛ oz.

This not only supplies us fat, but part of the one and a half ounces of protein we require, i. e., about 1/6 (17.6 per cent.) the chop is protein; hence 1/6 of 3⅛ ounces—1/6 of 25/8—about ½ ounce. The rest of the protein we may get from the potatoes and bread. Of course a great many combinations might be made. If we discard the bread and use potatoes only for our carbohydrate, the six ounces of carbohydrate would require over two pounds (say 33 ounces) of potatoes to supply it, for the carbohydrate content of potatoes is only between 1/5 and 1/6 of their total weight. Incidentally, this would add protein to the extent of about 1/45 (2.2 per cent.) of the total weight, i. e., about ¾ of one ounce, or nearly enough to make up the protein deficiency in the 3⅛ ounces of chop.

However, few people would wish to eat over two pounds of potatoes at a sitting; most people would rather substitute bread for part of it. The white bread given is nearly three times as strong in carbohydrates as the potatoes; hence one ounce of bread would replace nearly three ounces of potatoes, and furnish one-half more protein. Suppose then we replace say two-thirds of the 33 ounces of potatoes already figured by bread: i. e., leave out 23 ounces of potatoes and add 10 ounces of bread: then we will have about one and four-fifths ounces carbohydrate from the potato and about five and one-third from the bread, making over the six ounces required: and we should have one-quarter ounce of protein from the potato, about one ounce from the bread. Thus we would obtain nearly the proportions desired.

		Protein	Fat	Carbohydrate
Chop	3⅛ oz.	½ oz.	⅞ oz.	0.0
Potato	10 oz.	¼ oz.	1/10 oz.	1⅘
Bread	10 oz.	9/10 oz.	1/7 oz.	5⅓
		over 1½ oz.	over 1 oz.	over 7 oz.

There is an average wastage of 1C per cent., increasing with the vegetable and carbohydrate foods, and hence this combination would be very nearly correct. We have not figured in any butter or sugar: they would reduce the amount of fat required in the meat and bread; and would make up for some of the carbohydrate. The combinations that might be made are almost inexhaustible. Thus, another chop weighing 3⅛ ounces would make up for half the bread so far as protein was concerned, although doubling the fat required; the loss in bread would cut the carbohydrate by over 2½ ounces. However, the extra fat, having more than twice the heat value of the carbohydrate, would very nearly balance the loss of carbohydrate.

On the other hand, the potato might be cut in two without much damage to the meal, if half a chop (of 3⅛ ozs. in weight) were added, for this would more than supply the protein lost, and the fat added would supply enough heat value to make up the loss of carbohydrate. Of course, sugar in coffee, tea or taken as candy or in pies, would make up carbohydrate requirements very fast, for sugar, weight for weight, yields nearly double the carbohydrate in bread.

From the table which follows, "balanced rations" can be constructed for many of the ordinary foods.

Percentage Composition of Edible Portions of Certain Common Foods.

	Protein per cent.	Fat per cent.	Carbohydrate per cent.	Ash per cent.	Water per cent.	Heat value per lb.
ANIMAL AND FISH.						
Whole milk	3.3	4.0	5.0	0.7	87.0	310
Skim milk	3.4	0.3	5.1	0.7	90.5	165
Buttermilk	3.0	0.5	4.8	0.7	91.0	160
Cream	2.5	18.5	4.5	0.5	74.0	865
Butter	1.0	85.0	0.0	3.0	11.0	3410
Cheese (cream)	25.9	33.7	2.4	3.8	34.2	1950
Cheese (cottage)	20.9	1.0	4.3	1.8	72.0	510
Whole egg	14.8	10.5	0.0	1.0	73.7	700
White of egg	13.0	0.2	0.0	0.6	86.2	265
Yolk	16.1	33.3	0.0	1.1	49.5	1608
Lamb chop	17.6	28.3	0.0	1.0	53.1	1540
Pork chop	16.9	30.1	0.0	1.0	52.0	1580
Bacon	9.4	67.4	0.0	4.4	18.8	3080
Smoked ham	16.1	38.8	0.0	4.8	40.3	1940
Beefsteak	18.6	18.5	0.0	1.0	61.9	1130
Dried beef	30.0	6.6	0.0	9.1	54.3	840
Beef suet	4.7	81.8	0.0	0.3	13.2	3510
Lard	0.0	100.0	0.0	0.0	0.0	4080
Cod-lean	15.8	0.4	0.0	1.2	82.6	325
Mackerel-fat	18.3	7.1	0.0	1.2	73.4	645
Salt cod	21.5	0.3	0.0	24.7	53.5	410
Smoked herring	36.4	15.8	0.0	13.2	34.6	1355
Oyster	6.2	1.2	3.7	2.0	86.9	235
CEREALS, ETC.						
Corn (grain)	10.0	4.3	73.4	1.5	10.8	1800
Corn (green)	3.1	1.1	19.7	0.7	75.4	500
Corn bread	7.9	4.7	46.3	2.2	38.9	1205
Wheat (grain)	12.2	1.7	73.7	1.8	10.6	1750
Whole-wheat bread	9.7	0.9	49.7	1.3	38.4	1140
White bread	9.2	1.3	53.1	1.1	35.3	1215
Toasted bread	11.5	1.6	61.2	1.7	24.0	1420
Macaroni (cooked)	3.0	1.5	15.8	1.3	78.4	415
Oat(grain)	11.8	5.0	69.2	3.0	11.0	1720
Oatmeal (cooked)	2.8	0.5	11.5	0.7	84.5	285
Buckwheat (grain)	10.0	2.2	73.2	2.0	12.6	1600
Rye (grain)	12.2	1.5	73.9	1.9	10.5	1750
Rice (grain)	8.0	2.0	77.0	1.0	12.0	1720
SUGARS.						
Granulated	0.0	0.0	100	0.0	0.0	1860
Maple	0.0	0.0	82.8	0.9	16.3	1540
Stick candy	0.0	0.0	96.5	0.5	3.0	1785
Molasses	2.4	0.0	69.3	3.2	25.1	1290
Honey	0.4	0.0	81.2	0.2	18.2	1520
VEGETABLES.						
Potato	2.2	0.1	18.4	1.0	78.3	385
Parsnip	1.6	0.5	13.5	1.4	83.0	230
Onion	1.6	0.3	9.9	0.6	87.6	225
Celery	1.1	0.0	3.4	1.0	94.5	85
Shelled bean (fresh)	9.4	0.6	29.1	2.0	58.9	740
Navy bean (dry)	22.5	1.8	59.6	3.5	12.6	1600
String bean (green)	2.3	0.3	7.4	0.8	89.2	195

FRUITS.

	Protein per cent.	Fat per cent.	Carbohydrate per cent.	Ash per cent.	Water per cent.	Heat value per lb.
Apple	0.4	0.5	14.2	0.3	84.6	290
Fig (dried)	4.3	0.3	74.2	2.4	18.8	1475
Strawberry	1.0	0.6	7.4	0.6	90.4	180
Banana	1.3	0.6	22.0	0.8	75.3	460
Canned fruit	1.1	0.1	21.1	0.5	77.2	415
Fruit jelly	0.0	0.0	78.3	0.7	21.0	1455
Grapes	1.3	1.6	19.2	0.5	77.4	450
Raisins	2.6	3.3	76.1	3.4	14.6	1605
Grape juice	0.2	0.0	7.4	0.2	92.2	150

NUTS.

	Protein per cent.	Fat per cent.	Carbohydrate per cent.	Ash per cent.	Water per cent.	Heat value per lb.
Walnut	16.6	63.4	16.1	1.4	2.5	3285
Chestnut	10.7	7.0	74.2	2.2	5.9	1875
Peanut	25.8	38.6	22.4	2.0	9.2	2500
Peanut butter	29.3	46.5	17.1	5.0	2.1	2825
Cocoanut desiccated	6.3	57.4	31.5	1.3	3.5	3125