THE PROTEINS OF THE COTTONSEED

By DAVID WESSON

The object of this paper is to call attention to a material which, up to its present time, has been chiefly used for cattle food and fertilizer.

It is within the memory of many engaged in the Cotton Oil industry, when the oil was used to but a limited extent for food purposes, and then surreptitiously. The varying flavor of the oil and its bad odor in cooking condemned a large proportion of the production to the soap kettle.

Chemistry, as applied to refining methods and hardening has changed all this; so, except in cases where the seed is very badly damaged, there is little oil which cannot be used in the human dietary, and at prices comparing favorably with the higher priced vegetable oils and animal fats.

Protein is the most expensive constituent of our food. It is perhaps the most needed; without it, bodily growth and repair of the tissues cannot take place. The following table* gives its cost in some of the more common foods, which can be considered as chief sources of protein:

Food Product	Cost per lb.	Protein Cost per lb.
Lobster	40 cents	$6.75
Oysters (solids)	60 cents (per qt.)	5.00
Mutton chops (loin)	50 cents	3.70
Sirloin steaks	50 "	3.04
" "	45 "	2.74
Pork (roast loin)	30 "	2.25
Beef (stew meat)	15 "	1.14
Milk (at 15c per qt.)	7½ "	2.65
Potatoes	3 "	1.66
Wheat flour	4½ "	.39
Cornmeal	$2.25	.25
Cottonseed meal ($40. per ton)	2 cents	.05

* Taken from Langworthy, U. S. Department of Agriculture, 1905, Farmers Bulletin No. 85, page 19 (prices revised to present markets).

One can see at a glance that cottonseed furnishes the cheapest form of protein available in the markets of the world. The vital question is: Can it be made available for human food?

When we consider cottonseed meal (which attempts have heretofore been made to utilize), we find a material of varying composition.

First, it contains more or less hulls, which are a by-product of milling left in the meal by intention or otherwise.

Second, the seed from which the meal is made varies greatly. It is obvious that damaged seed cannot be looked upon as a source of wholesome or palatable food material.

Third, the residual oil in the meal will sooner or later turn rancid and damage its edible properties in the same manner as the oil left in whole-wheat flour.

Fourth, cottonseed meal contains gossypol, which varies in quantity according to the locality where the seed was grown and is more or less

toxic according to the treatment which the meats undergo in cooking. It also contains coloring matters and other extractives.

These are reasons enough why cottonseed meal can never be a popular food. Another reason is that cottonseed meal has been exploited as a flour substitute, whereas it properly belongs in the meat class.

To prepare cottonseed so it may be available for food we must first thoroughly separate the kernels from the hulls. The next step is to remove from the kernels all the oils, the so-called gums, the coloring matter, and the gossypol. This can be done by various solvents; benzol is perhaps the best for this purpose. The extracted material is light-yellow in color—almost tasteless; has less flavor, in fact, than cornmeal, and is a very light powder.

On boiling with two volumes of water it gradually turns to the color of well-cooked meat. When properly seasoned, it takes the place of meat in croquettes, sausages, hash, etc. In fact, so far as appearances and taste go, it is a true meat substitute.

Though the proof is in the eating, it is just as well to consider some chemical fundamentals. Let us first look to the amount of protein present in various foods.

	% Protein
Animal Foods	
Fresh Beef (Edible portion)	15.3 to 20.7
Veal Fresh " "	18.9 to 20.1
Lamb " " "	17.1 to 19.
Mutton " " "	14.6 to 17.2
Pork " " "	12.9 to 17.9
Pork Sides (very fat) Edible portion	8.8
Cottonseed Kernels (extracted)	60.
Poultry (Fresh)	
Chicken, (Edible Portion)	20.9
Fowl	18.7
Goose	15.8
Turkey	20.5
Cottonseed meats extracted	60.
Fresh Fish	
Black Bass (Edible Por.)	20.
Blue Fish " "	20.
Cod Steaks " "	18.1
Halibut " "	18.
Lake Trout " "	17.3
Mackerel " "	18.1
Eggs	
Edible Portion	13.
Dairy Products	
Whole Milk	3.2
Skimmed Milk	3.3
Cream	2.4
Cheese	25.1
Miscellaneous	
Gelatin	88.7
Vegetable Foods	
Corn Meal (Edible Por.)	7.5
Hominy "	6.8
Oatmeal "	13.4
Rice "	6.5
Whole Wheat Flour (Edible Portion)	10.7
Graham Flour (Edible Portion)	10,3
Family Flour (Edible Portion)	8.3
Vegetables	
Beans (Lima) dried	12.8
" White	15.8
" Baked	4.8
Peas (dried)	17.3
" (green)	2.2
Potatoes	1.7
Nuts	
Almonds	17.8
Butternuts	23.7
Chestnuts	5.3
Filberts	15.3
Hickory Nuts	13.1
Peanuts	21.

Quantitatively, cottonseed meats after extinction evidently contain something over three times as much protein as is present in the various meats, fish and eggs; nearly twenty times as much as in milk; six or seven times as much as is present in the cereals; and four or five times as much as in peas and beans, the two vegetables relied upon by vegetarians to take the place of meat. Nuts are the only other vegetable foods approaching the meats in percentage of protein and, as will be noted, they carry about as much as the meats. The price of nut protein is as high if not higher than that of beef and mutton.

The qualitative composition of the protein regardless of origin is of the greatest importance. This is perhaps best illustrated in the case of gelatin. As compared with true protein, it shows that the value of the various proteins in nutrition may depend on their various amino acids. Lusk (Science of Nutrition, 3rd Edition, page 371) gives a table by Thomas, showing the different biologic value of different proteins as measured by the percentage quantity of body protein which their ingestion will supply. It shows the enormous differences which exist as follows:

Ox Meat	104	Yeast	71
Cow Milk	100	Casein	70
Fish	95	Nutrose	69
Rice	88	Spinach	64
Cauliflower	84	Peas	56
Crabmeat	79	Wheat Flour	40
Potatoes	79	Cornmeal	30

The reason for these biologic differences lies in the Amino Acid contents of the different proteins, and has been proven by experiments on growing animals.

Osborn and Mendel have shown (Journal of Biological Chemistry, Vol. XXIX, Mar., 1917) that "Cottonseed kernels were unsatisfactory as a food; but the cottonseed meal and flour, tested, were valuable foods for growing rats, both when used as the sole source of protein in the food or when used in smaller quantities to supplement other less efficient protein concentrates."

W. Breeze Jones and Frank A. Conke (Journal Biological Chemistry, Vol. LXIV No. 3, June, 1925) report finding two globulins amounting to 2.59 and 16.00 per cent respectively. No nucleic acid was found. Lusk (Science of Nutrition, page 378, 3rd Edition) quotes the globulin of the cottonseed as among those which allow growth.

Taking all the above facts into consideration, it seems fair to conclude that in the nitrogeneous portion of the cottonseed we have an abundance of protein of a high biologic value; that cottonseed meats can be prepared free from oil, gossypol, coloring and extractive matters, etc., to produce a palatable and nutritious food; that this food can be used as a meat substi-

tute, furnishing high biologic protein cheaper than any food now obtainable.

The field is so new that further experiments should be made to find out fully the exact relation which this material bears to other foods. For instance, we find extracted cottonseed meats from North Carolina seed show, on analysis, 58.75 per cent protein, 0.99 per cent oil, 8.69 per cent moisture, leaving 31.57 per cent of various carbohydrates.

It seems quite desirable for us to know something more of the nature of this residue. Feeding experiments have demonstrated that it is harmless; but it would be very desirable to know more of its chemical nature and just what part it plays in nutrition.

I wish to take this occasion to thank Mr. H. P. Trevithick of the Bureau of Chemistry of the New York Produce Exchange of his analysis of the extracted meats. I also wish to make a special acknowledgment of the valuable assistance derived from Lusk's "Science of Nutrition," 3rd Edition, from which the various tables given in the paper have been derived, also various facts regarding the nature of the different proteins.

HOME MADE PIE IN A. D. 2000

Give me a spoon of oleo, Ma,
And the sodium alkali,
For I'm going to make a pie, Mamma!
I'm going to make a pie.
For Dad will be hungry and tired, Ma,
And his tissues will decompose;
So give me a gram of phosphate,
And the carbon and cellulose.
Now give me a chunk of casein, Ma,
To shorten the thermic fat,
And give me the oxygen bottle, Ma,
And look at the thermostat.
And if the electric oven is cold
Just turn it on half an ohm,
For I want to have supper ready
As soon as Dad comes home.

Exchange.