

ASPECTS OF NUTRITION AND METABOLISM IN CHINA.

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This report is an attempt to summarize the present state of knowledge on the nutrition and metabolism of the Chinese. China presents the interesting situation of a people who have lived in almost complete isolation, whose dietary habits therefore must represent definite responses to definitely local stimuli or racial traits. And the length of time involved has brought China more nearly to a state of economic and nutritional equilibrium than can ordinarily be attained. The adjustments which the human mechanism has made to these influences present interesting topics of study. Moreover, the Chinese people are sufficiently numerous and homogeneous that a reliable biochemical average is easily possible.

Some of those who first came in contact with China's nutrition problem expected to find a mechanism which not only operated on an entirely different intake level, but which also involved fundamental differences in the metabolic process such as might characterize a distinct species. In this direction there has been disappointment. The first studies, begun a little over ten years ago, were concerned with a systematic examination of food materials and their analysis. It was shown that the food materials of the Orient were quite similar to those of the Occident, apart from one or two items such as the soy-bean which China had been led by her economic situation to exploit to a peculiar degree.

Certain characteristics of the food in take are shown in the accompanying Tables I to III. The division into North China and South China is a well-recognized one. Climate, habits of life and agricultural conditions differ greatly in these two areas. The figures for North China are averaged from the diets of about 1,500 individuals from middle-class families, the dietary records for each individual or family extending over periods of several weeks or more. Some of these data were gathered by the author in the Chee-lee University laboratory; the remainder include those reported by Wu and Wu¹ in Peking. The figures for the American diet are taken from Sherman.² The data for South China are reported by Powell,³ and are for day-laborers; the day-laborer represents an extreme rather than a middle-class average. The most outstanding feature of these tables is the high consumption of cereals (wheat bread in North China and steamed rice in South China), the absence of dairy products, the small amount of meat consumed and the low values for total protein.

¹H. Wu and D. Y. Wu, Chin. J. Physiol. Rep. Ser. 1: 135, 1928.

²H. C. Sherman, "Chemistry of Food and Nutrition," 1926.

³H. N. Powell, Chin. J. Physiol. Rep. Ser. 1: 129, 1928.

Eggs	0.8	0.8	0	0	4.8	1.8
Milk and cheese	0	0	0	0	11.8	2.1
Other foods	0.8	0.8	0	0	0.8	0.8

Observations reported elsewhere on Chinese dietary habits show low protein, low fat, low carbohydrate, and low energy intake. TABLE I. Chinese Diets. Composition in Percentages by weight

	North China	South China	United States
Cereals.....	57.0	59.7	25
Legumes.....	7.8	18.2	20
Vegetables and fruits	27.1	21.0	14
Sugar and starch.....	0.2	0.9	18
Fats and oils.....	0.8	1.1	5
Meat and fish.....	3.9	0	15
Eggs.....	0.5	0	3
Milk and cheese.....	0	0	0
Other foods.....	2.7	0	0

TABLE II. Chinese Diets. Intake of total food, protein, fat, carbo-hydrate and Calories per man per day.

	North China	South China	United States
Total food (gms)	1188.0	1303.0	3256.0
Total protein (gms)	86.4	67.1	106.0
Total fat (gms)	34.1	27.2	60.0
Total carb. (gms)	537.0	604.9	1000.0
Total Calories	2794.0	3006.0	3256.0
Calcium (gms)	0.337	0.337	0.740
Phosphorus (gms)	1.178	1.178	1.630
Iron (gms)	0.0187	0.0187	0.0179
Average weight of man (kilos)	60.0	54.0	70.0

TABLE III. Chinese Diets. Percentage Distribution of Protein and Energy among Different Groups of Food Materials.

	North China		South China		United States	
	Pr.	En.	Pr.	En.	Pr.	En.
Cereals	75.2	83.5	84.2	91.9	37.3	38.2
Legumes	10.6	8.9	6.8	1.2	10.5	12.1
Vegetables & fruits	4.5	2.9	9.0	2.8	0.1	10.1
Sugar and starch	—	0.5	—	0	0.3	10.3
Fats and oils	—	3.5	—	4.1	0.3	10.3
Meat and fish	8.1	4.8	0	0	35.3	19.0
Eggs	0.8	0.2	0	0	4.6	1.8
Milk and cheese	0	0	0	0	11.6	8.1
Other foods	0.8	0.9	0	0	0.3	0.4

Observations reported elsewhere⁴ on Chinese dietary habits show how greens, raw vegetables, sprouted soy-beans, short-time cooking, are some of the qualitative devices which blind experimentation has led the Chinese to employ to supply vitamins and similar essentials. Certain districts have reverted to a mixture of cereals rather than depend on a single vegetable protein, apparently with profit. Abundance of roughage is characteristic of the dietary; constipation and the use of pills are almost unknown.

The value for protein though low is in effect still lower when it is remembered that the oriental diet is a very bulky diet and that the coefficient of digestibility of protein is lowered accordingly. Atwater, quoted by Sherman,² gives 92 per cent, as the degree of digestibility for protein in the ordinary American mixed diet. Oshima⁵ finds 76 per cent, for the more bulky vegetarian diet, while McCay,⁶ studying the bulky rice diets of India, shows that a consumption of 766 grams of rice (dry weight) per day will lower this coefficient to 52 per cent. The South China diet here reported is such a rice diet; in other words, 67.1 grams of ingested protein per day becomes an effective 35 grams per day! No experimental data on the coefficient of digestibility of protein in the Chinese vegetarian diets have as yet been reported. We are hoping to secure such data.

There has been too great a tendency on the part of the China enthusiast to extol rather than sanely to evaluate. It is commonly asserted that the mass of the Chinese people live just on the fringe of starvation, or just within the fringe of an animal existence. This is true, and while it is interesting to note how China by a sort of blind experimentation has selected just those food materials which under prevailing economic conditions most effectively meet nutritive needs, the Chinese people have been too often complimented on their ability to thrive on this fringe of existence. Attention has been called to the tall, apparently robust physique of Shantung, and the world traveler reminds us of limitless capacity for toil and labor, but the fact remains that the mass of the people are dangerously underfed. Nutritional science today is interested in the optimum metabolism, not in mere existence, and the problem before the Chinese people is one of improved growth and vigor rather than mere maintenance of equilibrium.

Famines in China show definitely that the Chinese diet allows no emergency reserve, for a slight lowering of the quality and quantity of food intake produces immediate disaster. Careful observations on athletic squads, school kitchens and hospital groups have shown how intimate is the relationship between food intake and health. Overwork among students manifests itself, not as nervous breakdown, but as tuberculosis. One director of a large nursing school found that she could reduce the annual tuberculosis casualties among her student nurses

⁴W. H. Adolph, Amer. Food J., 20: 441, 1925.

⁵K. Oshima, "Japanese Investigations on Nutrition of Man," 1905.

⁶D. McCay, "The Protein Element in Nutrition," 1912.

either by improving the food, or by reducing the number of hours of work per day. Either method was equally effective. We and Wu¹ have fed typical Chinese and typical American diets to laboratory rats and have demonstrated the superior growth-promoting properties of the latter type of diet.

Famines in China have furnished excellent opportunities for observing dietary requirements. In the famine of 1921, one of the relief commissions set out definitely to determine the minimum amount of food for a living diet. It was determined that a daily ration of ten ounces of mixed cereal and soy-bean plus four ounces of vegetable and a small amount of salt, yielding a total of 1,200 Calories, would support a man if he did no work. Seventeen men were sustained on this diet for ten weeks, weighings being taken every few days. The report is that the men seemed quite content on this diet and looked well. Others on the same diet but who worked during this period lost heavily and had to receive a double ration. These data then were used as the basis for a relief ration for some tens of thousands of people. Such data almost approach the conditions of a basal metabolism test. In this same famine the American Red Cross employed an average of 20,000 men in road construction work for seven months; they were placed on a well-balanced diet furnishing about 2,800 Calories, the diet being composed essentially of mixed cereals with fresh vegetables.⁷ At the same time in an adjoining area a similar group were fed a similar cereal ration without the fresh vegetable admixture. The second group were observed to be lacking in energy; their general health was poor, and they became an easy prey to contagious disease. These data were as convincing as any present-day experiments on laboratory rats, and in addition the experiment involved a large number of individuals. Lack of transportation in China, as well as the existence of natural division lines, means that it is possible to set off large areas for experimental purposes, and in times of famine thousands of people become available en masse as experimental subjects.

The tables presented show a very small meat intake. Table IV indicates the place which meat occupies in the diets of the world. The meat intake in South China¹¹ is apparently lower than the recognized American and European standards.

TABLE IV

Meat consumption of the principal countries of the world (Grams per capita per day)

United States	149
Great Britain	130
France	92
Belgium and Holland	86
Austria-Hungary	79
Russia	59
Spain	61
Italy	29
Japan	25
China (North)	15

⁷H. C. Embrey, Am J. Publ. Health, 12: 514, 1922.

nations. The figure for China is estimated from trade reports; data for the other countries are those quoted by Robertson.⁸ The importance of meat may still be a moot point, but the experience of the Chinese people would seem to confirm the thought that a vegetarian diet is at least not impossible. Their present food habits have certainly not been greatly altered for at least 1,500 years, and possibly not for 3,000 years. There is no room here for philosophizing on the place of meat in the diet. One who has been in contact with the nutrition problem in the Orient willingly subscribes to the observation that meat diet seems to be characteristic of the most aggressive peoples of the world.

The figure for calcium (Table II) is low. The amount may not be low enough to cause disease, but like many of the other dietary factors it seems to be just low enough to prevent optimum growth. Public health authorities report the following as the common diseases of China: tuberculosis, beri-beri, xerophthalmia, rickets and osteomalacia, while those infrequent are: appendicitis, gastric ulcer, gout, rheumatism, gallstone and obesity. Note that most of these are recognized as nutritional disturbances.

Interest in the basal metabolism of the oriental peoples was stimulated by an experiment on a few Chinese women students in an American institution which showed a lower basal metabolic rate.⁹ Takahira¹⁰ in Japan had concluded that the basal metabolism of Japanese and Americans is essentially the same. Data gathered by Earle¹¹ for China, as yet incomplete, indicate that the basal metabolism for the Chinese may be slightly lower. Ling,¹² studying blood constituents, finds that the mean for North China exhibits only very slight differences from the normals for Americans. The blood pressure of Chinese would seem to be lower than the normal in the United States.¹³ The Chinese as a rule excrete less chlorine than Westerners.¹⁴ Metabolism studies show that higher amounts of creatinine and uric acid are excreted;¹⁵ the higher excretion of uric acid may be related to the tea habit, while in South China at least the amount of ammonia nitrogen excreted is exceptionally high.¹⁶ But South China is really subtropical, and the whole subject of metabolism in the tropics is still unsolved. Among the most interesting data being collected are those which show how the blood pressure of the American moving his residence from the United States to North China approaches the lower Chinese norm.¹³ The basal metabolism for Westerners in South China¹¹ is apparently lower than the recognized American and European standards.

Dietary and metabolic habits must be either inherited or environmental. While many data still remain to be gathered, evidence so far points to environmental factors as the influential ones. South China and North China present distinct types of climate, and when the southern Chinese emigrates to North China and finally adopts the food habits of North China, which incidentally he does with reluctance, his sons begin to approach

⁸T. S. Robertson, "Principles of Biochemistry," 1924.

⁹G. MacLeod, E. E. Crofts, F. G. Benedict, *Am. J. Physiol.*, 73:444, 1925.

¹⁰H. Takahira, "Progress of the Science of Nutrition in Japan," p. 11, 1926.

¹¹H. G. Earle, *Chin. J. Physiol. Rep. Ser. 1*: 59, 1928

¹²S. M. Ling, *Chin. J. Physiol. Rep. Ser. 1*: 119, 1928.

¹³C. L. Tung, *Chin. J. Physiol. Rep. Ser. 1*: 93, 1928.

¹⁴B. E. Read and S. Y. Wong, *Phil. J. Sc.*, 22: 127, 1923.

in stature and weight the larger standards of North China.¹⁷ Studies on the Japanese who have emigrated to the United States¹⁸ show that the new environment of food and climate is producing a larger physique. Southern Chinese who emigrated to Hawaii are found to have attained a greater average height after several generations in the new environment.¹⁹ There seems to be general agreement that the different races which make up the population of the United States now metabolize on the same plane, and that so-called racial metabolic traits, if there were any, have quite disappeared. There may even be an inherited racial difference between the northern Chinese and the southern Chinese, but it would appear to have no influence on the metabolism of the organism equal to that of climatic environment and dietary habits.

In conclusion, dietary studies in China indicate wide-spread conditions of undernutrition. Climate and environment in turn seem to have produced a temperament which accommodated itself to a low protein consumption and to a lowered metabolism generally. A type of blind experimentation has aided the Chinese people in reaching probably the best solution of a bad situation.

15S. Y. Wong, Chin. J. Physiol. Rep. Ser. 1: 123, 1926.

16J. A. Campbell, Bioch. J., 13: 239, 1919.

17H. Necheles, Chin. J. Physiol. Rep. Ser. 1: 80, 1926.

18K. Kansaka, Annals Am. Acad. Pol. Soc. Sci., 83: 88, 1921.

19V. B. Appleton, China Med. J., 40: 259, 1926.