

Dietary protein, amino acids and their relation to health

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Against a background of economic and dietary change in China since the 1980s some Chinese scientists have advocated an increase in the production of animal food products and therefore (from a low baseline) of animal protein intake. The 1990 Chinese total diet study allowed the role of individual amino acids in the diet to be considered. Taurine, present in seafood, is singled out for its possibly antihypertensive effect.

The Chinese diet is mainly based on grain and other plant foods. Dietary protein, especially animal protein, is much lower than that in western diets. According to the 1982 nationwide nutrition survey, the daily protein intake of a standard Chinese man is 66.8g. Protein of animal origin

only contributed 11.4% of the total protein intake¹. Many scientists in China believe that this amount is inadequate and emphasize the need to increase protein consumption, especially animal protein. They consider that increasing animal protein production should be a major goal of national policy for agricultural development². Along with the development of our national economy, remarkable changes have occurred since the 1980s in the dietary composition of most Chinese populations.

An opportunity to assess the dietary protein status of the Chinese population recently arose with the completion of the Chinese total diet study in 1990³. The food consumption pattern in 12 provinces in four areas of China was determined by a household dietary survey. Food samples were collected from the 12 provinces and cooked. Then, the food samples were combined to

Table 1. Protein intake and sources in four Chinese areas in 1990.

Area	Protein intake (g)	Animal protein (%)	Legume protein (%)	Grain protein (%)	Energy from protein (%)
Northern 1	62.1	23.3	11.6	48.5	11.5
Northern 2	73.4	11.5	6.5	69.8	12.0
Southern 1	61.3	32.1	6.9	46.9	11.6
Southern 2	59.1	22.2	8.6	52.8	11.3
Average	64.0	21.8	8.3	55.2	11.6
1982 survey	66.8	11.4	10.7	66.6	10.8

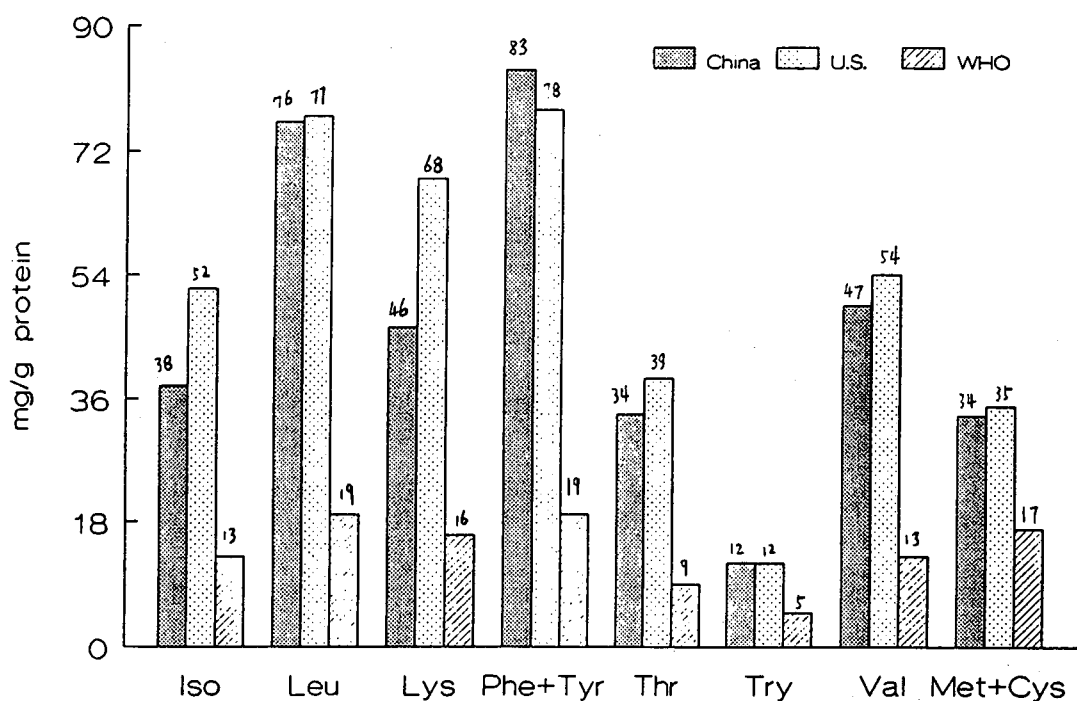


Figure 1. Amino acid pattern of Chinese diet compared with the US diet and WHO requirement.

make four market baskets of total diet for laboratory analysis. Total nitrogen and amino acid contents in the four market baskets were analysed. The amount of protein intake and amino acid pattern of the diet of a standard man (18–45 years old, 60 kg body weight, light physical activity) was obtained. The results showed that the average protein intake was 64.0g/day (Table 1), which was very close to the 66.8g in the 1982 nationwide nutrition survey. However, the animal intake reached 21.8 % of total protein which was much higher than the 11.4 % in 1982.

The amino acid pattern in the diet in four surveyed areas all met the WHO requirement pattern for adults (Fig 1). If we assume that the digestibility of mixed protein in Chinese diet is 90 %, the protein allowance for adults would be: $0.75\text{g}\cdot\text{kg}^{-1}\cdot 0.9^1\cdot 60\text{kg} = 0.83\text{g}\cdot\text{kg}^{-1}\cdot 60\text{kg} = 50\text{g}$. The average protein intake of a standard man in the four areas all exceeded this level.

It is generally believed that the human body has the ability to dispose of excess nitrogen. Therefore, protein intake moderately above requirement is supposed to be safe. However, studies in recent years have shown that high protein, especially high animal protein intake, may have an adverse effect on human health.

Zhao et al. reported⁴ that the energy intake of Shanghai people from grain products decreased from 80–83 % to 68–72 % and that from animal foods increased from 6.5–8.5 % to 17.5–18.0 % from the 1950s to the 1980s. Along with the changes of dietary pattern, the disease pattern has also changed. For example, the leading causes of mortality for the Shanghai population in 1985 were malignant tumours, cerebrovascular diseases and ischemic heart disease, while in the 1950s, measles, tuberculosis and other communicable diseases were the leading causes of death. Animal foods are rich in saturated fat and also in animal protein. It is usually difficult to separate their independent effects. The ability of animal protein per se to increase blood cholesterol levels in experimental animals and humans has been reported by Carroll⁵ and Sirtori et al.⁶

According to the study carried out by Junshi Chen and Colin Campbell in 1983 in 65 rural Chinese coun-

Table 2. Dietary protein, sulphur amino acids and urinary Ca excretion.

	Basal diet	High protein diet	Basal diet plus taurine	Basal diet plus Met+Cys
Protein intake (g/d)	66.9±0.62 ^a	107.5±2.75 ^b	68.8±0.88 ^c	69.1±0.71 ^c
Ca intake (mg/d)	543.0±1.50	556.0±1.9	542.0±2.5	542.0±2.20
Urinary Ca (mg/24h)	183.0±17.40 ^a	219.0±14.50 ^b	185.0±21.90 ^a	216.0±21.40 ^b
Urinary SO ₄ (mEq/24h)	38.2±2.25 ^a	82.0±2.20 ^b	41.4±2.17 ^a	88.1±5.05 ^b

^{a,b,c} = $P < 0.01$ vs different letter (a: vs. b, c; b: vs. a, c; c: vs. a, b).

ties, animal protein intake was significantly associated with plasma total cholesterol, non-HDL-cholesterol and other cholesterol fractions which are correlated in turn with cancer mortality rate of several sites⁷.

It is also well known that a high protein diet can increase the calcium excretion and cause calcium loss

Table 3. Taurine content of meats, poultry and aquatic products in China (mg/100 g edible portion)

Food	Taurine conc.	Food	Taurine conc.
Conch	850	Hairtail fish	56
Inkfish	672	Yellow croaker	88
Blood clam	617	Eel	91
Clam	496	Chicken leg	378
Shellfish	332	Chicken breast	26
Crab	278	Pork	118
Prawn	143	Pig heart	200
Sole	256	Pig kidney	120
Crucial carp	205	Pig liver	42
Silver carp	90	Beef	64

Taurine was not detected in egg, bean, rice and other plant food.

from the bone. The result of a controlled human study on young men carried out in our laboratory showed that when fat and phosphorus were kept constant and 40 g egg white protein was added to the basal diet, which provided 67 g of protein per day, the urinary calcium excretion was significantly increased and associated with increased sulphate excretion (Table 2). When the basal diet was supplemented with methionine and cystine the same effect on Ca and sulphate excretion was observed⁸. Abelow et al. also reported that strong associations were found between animal protein intake and the prevalence of hip fractures⁹.

From the above-mentioned studies, it is suggested that high protein intake may enhance the risk of chronic degenerative diseases, especially coronary heart disease and osteoporosis.

It has been known that different kinds of amino acids have different effects on health. Kritchevsky et al. reported that the ratio of lysine to arginine in the diet can influence serum cholesterol levels¹⁰. Yamori et al. suggested that the deficiency of certain amino acids, especially tyrosine and possibly tryptophan, may influence blood pressure in hypertensives¹¹. In contrast, Wurtman et al. found no convincing evidence that these two amino acids were involved in the pathogenesis of human hypertension¹².

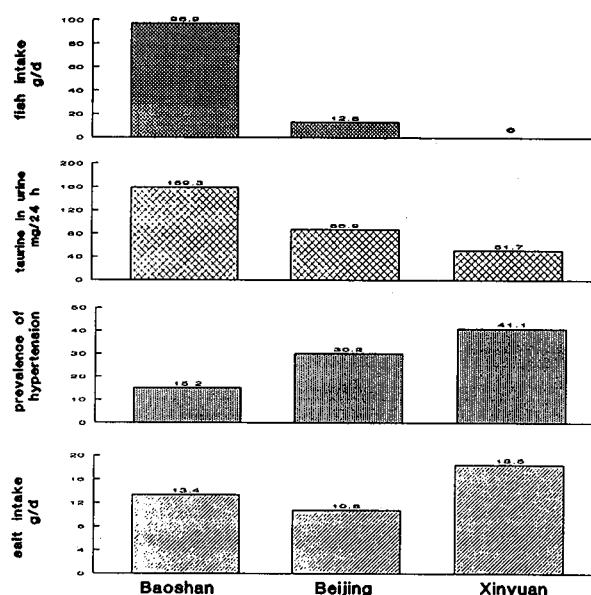


Figure 2. Prevalence of hypertension in relation to fish intake.

Recently, it has been suggested that taurine may act as an antihypertensive substance through central and peripheral mechanisms in animal models and in human essential hypertension¹³. Taurine is high in seafood and not present in plant food (Table 3)¹⁴.

The lowest prevalence of hypertension was among people that lived in fishing areas and this may be related to the high taurine content in their diet.

Fujita et al. reported that when 6 g taurine/day was given to young adult males with borderline hypertension for 7 days, their systolic and diastolic blood pressure decreased significantly to levels similar to those of the placebo treated controls¹⁵.

The same effect from taurine was also found by nutritionists in China. Zhang et al. compared the blood pressure of three populations living in fishing and farming areas in China and found that the blood pressure of populations in the fishing area was the lowest. Serum and urinary taurine content were negatively related to blood pressure. They also found that sodium excretion was positively associated with taurine excretion¹⁶.

In a nutrition and health survey on the middle-aged and elderly in different areas of China carried out in 1987 by our department, the Department of Nutrition for the Elderly, at the Institute of Nutrition and Food Hygiene, we also found that the prevalence of hypertension was negatively correlated with fish intake and urinary taurine excretion. The prevalence of hypertension of people in the fishing area Baoshan was much lower than that of people in Beijing, although sodium chloride intake of Baoshan residents was higher than in Beijing residents (Fig 2). It seems that a habitual high intake of taurine may contribute to a decreased risk of hypertension. Further investigations are needed before any conclusion can be obtained.

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*Asia Pacific Journal of Clinical Nutrition 1994; 3: 131-134***膳食蛋白質、氨基酸與健康的關係****摘要**

鑒於 1980 年代中國經濟和膳食基本情況的改變，一些中國科學家提倡增加動物性食品的生產和進食。1990 年中國的膳食研究已考慮到個別氨基酸在膳食中的作用。本文報導了海味中含有的，並可能有抗高血壓作用的牛磺酸。