SHORT COMMUNICATIONS

PROTEIN VALUES OF PAKISTANI DIETS AT DIFFERENT LEVELS OF CALORIC INTAKE*

S. MAQSOOD ALI† AND D. S. MILLER

Human Nutrition Research Council, London, England.

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Introduction

Protein malnutrition in under-developed countries is frequently associated with low caloric intake brought about by the insufficiency of food and the lower economic status of the people. It may also be aggravated by climatic conditions; for instance during the hot summer months the people are prone to drink a lot of water and to voluntarily reduce their food intake. In an earlier paper[1] the average per caput consumption of Pakistan, "at the retail level" has been shown to be 2,000 calories. According to more recent estimates,[2] calorie requirements for the Far East are placed at about 2,300 calories per caput per day, so that an average Pakistani consumes approximately 85% of his requirements. In view of the very big economic gaps prevailing in Pakistan, it is quite conceivable that some sections of the population may be subsisting at calorie intakes between 50—60% of their total requirements.

In assessing the protein values of diets the protein-calorie ratio is not the only important factor but also the total energy intake. If this is reduced below a certain level, protein in the food is burnt to meet the energy needs of the body and consequently the efficiency of utilization falls.[3] Forbes and Yohe[4] have shown no change in the biological value of a diet when the food intake of rats was reduced from 8 to 6 g. per day, but a fall from 99 to 69 when the food intake was further reduced to 4 g. per day. At low caloric intakes, the protein value of a diet will depend upon the energy available for protein anabolism. Hence one might expect a constancy of net dietary protein calories% (N.D.p Cals.%) over a certain range of food intakes and a critical value below which it begins to fall with the reduction of caloric intake in relation to needs.

In order to assess the extent of reduction in the net dietary protein value at low energy level, the East and West Pakistan diets were fed in limited quantities expressed as calories per kg. body weight to the power of 0.73. This expression was chosen because requirements for basal metabolism expressed in these terms is constant for all species from mice to elephant and is 70 calories per kg. body weight to the power 0.73.[5]

Materials and Methods

The various ingredients employed for the preparation of East and West Pakistan diets have been described in a previous communication.[6] The methods used in these investigations are the same as reported earlier.[7]

Results

The analytical data for the diets are given in Table 1. Observed values of N.D.p Cals.% at different levels of caloric intake, expressed as calories per kilogram of body weight to the power of 0.73, are shown in Table 2 and illustrated in the Figure 1.

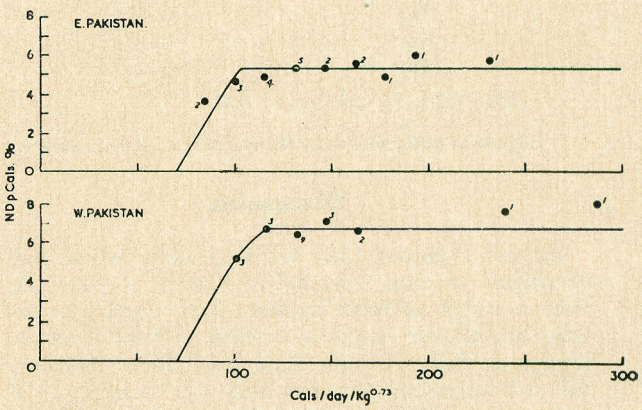

Fig. 1.—Protcin values of East and West Pakistan diets at various levels of caloric intake. The numerals show the number of independent trials at each level of intake.

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†Now at the West Regional Laboratories, Pakistan Council of Scientific and Industrial Research, Lahore.

TABLE 1.—COMPOSITION OF EAST AND WEST PAKISTAN DIETS.

Diet	N.%	Cals./g	Protein Cals. %	NDp* Cals. %
East Pakistan	1.49	4.16	9.0	5.3
West Pakistan	2.2	4.32	13.3	6.8

*Mean values of the diet when fed *ad lib*.

TABLE 2.—NDp CALS.% OF PAKISTAN DIETS AT DIFFERENT LEVELS OF CALORIC INTAKE (CALS./KG. 0.73 BODY WEIGHT).

EAST PAKISTAN

Cals./g.=4.16
Protein %=9.3
Protein Cals%=8.95

(Cals./kg.)$^{0.73}$	NDp Cals.%
85	3.7(2)*
101	4.7(3)
116	4.9(4)
132	5.3(5)
147	5.3(2)
163	5.6(2)
178	4.9(1)
194	6.0(1)
232	5.7(1)

NDp Cals.% ad lib = 5.3

WEST PAKISTAN

Cals./g=4.32
Protein %=14.4
Protein Cals.%=13.3

101	5.2(3)*
116	6.7(3)
132	6.4(9)
147	7.1(3)
163	6.6(2)
240	6.6(1)
287	8.0(1)

NDp Cals.% ad lib = 6.8

*Figures in parenthesis show the number of determinations.

Discussion

Figure 1 shows that for any diet, when fed *ad libitum* to rats, the N.D.p Cals% is constant over a range of food intakes, but, when the intake is reduced below a certain critical level, it begins to fall. In the East and West Pakistan diet it is approximately 100 and 115 (Cals./kg.)$^{0.73}$ with average N.D.p Cals.% of 5.3 and 6.8, respectively. If the intake falls below the above values, for example at 90 (Cals./kg.)$^{0.73}$ the N.D.p Cals.% is 4 in each case and the effect of the quality of the protein is totally abolished. It can also be seen from Figure 1 that, when the intake of West Pakistan diet is reduced from 120 to 100 (Cals./kg.)$^{0.73}$ i.e. approximately 50% restriction, the N.D.p Cals.% falls from 7 to 5.

These results were extended by Miller and Payne [8] who determined the N.D.p Cals.% of four other diets at the various levels of caloric intake and on theoretical grounds, they presented the following equation for the prediction of protein values of diets when fed under conditions of caloric restriction.

$$\text{N.D.p Cals.\%} = 17\left(1-\frac{70}{C}\right),$$

Where C is caloric intake per day per kg. body weight to the power of 0.73.

In Figure 1 the curved portion is derived from the above equation, and the linear portion represents the mean N.D.p Cals.% over the *ad libitum* range of caloric intake.

As a practical application of this work in human dietetics, one can predict the protein value of diets under conditions of caloric restriction. Thus a child whose protein intake is adequate but does not take sufficient calories according to his requirements will produce clinical signs of protein malnutrition known as marasmus and kwashiorkor. A nomogram[8] has been constructed which gives a relationship between weight of the individual, caloric intake and N.D.p Cals%.

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