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RELATIONSHIP BETWEEN AVAILABLE AMINO ACIDS AND PROTEIN
VALUE OF CEREAL - LEGUME DIETS

Kausar Almas* and M, Akmal Khan

Available lysine and sulphur amino acids in cereal-legume diets were determined chemically and chemical scores (CS) were calculated. The results indicated that there was a significant correlation ($r=0.99$) between CS and the available lysine and CS could be predicted from the regression equation $CS = 1.23 + 1.88 \times \text{available lysine}$. This indicates that lysine is the first limiting amino acid in these diets. The estimation of available lysine may be regarded as a single, simple chemical technique for testing protein quality of cereal grains and for quality control of damage to lysine in processed foods.

INTRODUCTION

The nutritive value of dietary protein is governed by the pattern and quantity of essential amino acids present in it. The presence of one or more of the essential amino acids in inadequate amounts would decrease the nutritive value of proteins. In developing countries, cereals constitute the bulk of an average diet and are known to be limited by lysine (Bressani and Elias, 1974; Khan, 1981). On the other hand legumes are rich source of lysine but are limited by sulphur amino acids (Khan *et al.*, 1979). Legumes are mostly consumed together with cereals, so that surplus of one amino acid in one food makes good the deficiency of the limiting amino acid in the other food (Khan *et al.* 1976, 1977, 1979). However, mixed diets have been reported to be deficient in lysine (Khan and Eggum, 1978) and in sulphur amino acids (Miller and Donoso, 1963).

Since lysine is easily damaged on cooking its availability may be considered of primary importance in regulating the protein quality of processed foods of cereal origin. In this communication, the chemical estimation of available lysine and sulphur amino acids and their relationship with the protein quality of cereal-legume diets is reported.

* Department of Rural Home Economics, University of Agriculture, Faisalabad.

MATERIALS AND METHODS

Five cereal-legume diets; viz. wheat bread+chickpea dhal; wheat bread+mung dhal; wheat bread+mash dhal, wheat bread+lentil dhal and rice (boiled)+lentil dhal were prepared according to the following traditional cooking practices. Dough prepared from wheat flour was used for making bread on hot iron plate for 3-4 minutes. Whereas legumes such as mung and lentil, and mash and chickpeas were cooked for 15-20 and 60-70 minutes respectively, to which spices had been added. Onions fried in about two tablespoon fulls of fat were then mixed with cooked legums. Similarly rice was boiled in water (1-2 w/v) for 15 minutes. All diets were dried in an air oven at 50°C, ground and then analysed, for nitrogen by Kjeldahl method. Each diet contributed 85% protein from cereal and 15% from legume. Available lysine was determined according to Hurrell and Carpenter, (1975) also available methionine and cysteine in diets were estimated by the method of Pieniazek *et al.* (1975) Chemical score based on target mixture (Bender, 1965) and scoring pattern (FAO/WHO, 1973) was then calculated.

RESULTS AND DISCUSSION

Table 1 shows the content of available lysine, methionine and cysteine and the chemical score based on available lysine values.

Table :- 1 Available lysine, methionine and cysteine (g per kg crude protein) and chemical score of cereal-legume diets

Diets	Crude protein (Nx 6.25) g/kg	Available lysine	Available methionine	Available cysteine	Chemical score based on available lysine	
					Target mixture, Bender, 1965	FAO/WHO pattern- 1973
1. Wheat bread + chickpea dhal	139.1	30.0	15.7	18.0	58	55
2. Wheat bread + mung dhal	128.3	29.1	15.5	17.1	56	53
3. Wheat bread + mash dhal	143.6	32.2	16.7	17.0	62	59
4. Wheat bread + lentil dhal	117.3	28.3	16.2	18.2	54	51
5. Rice boiled + lentil dhal	115.5	35.1	26.2	18.1	67	64

AVAILABLE AMINO ACIDS IN DIETS

The chemical score (CS) of protein foods calculated from their amino acid analysis has been shown to correlate with their biological value (Bender, 1973). It is apparent from Table 1 that the nutritional value expressed in terms of chemical score of cereal-legume diets is dependent on available lysine values. A direct relationship between the available lysine and the chemical score, based upon amino acid target mixture (Bender, 1965), is represented by the following regression equation :

$$\text{Chemical score} = 1.23 + 1.88 \times \text{available lysine}$$

According to which the following values were obtained :-

$$r = 0.99, \quad s = 2.74, \quad s_b = 0.37$$

(where s is the deviation from regression and s_b is the deviation of regression coefficient).

The regression coefficient differed significantly from zero ($P < 0.01$). The above results are also illustrated by figure 1.

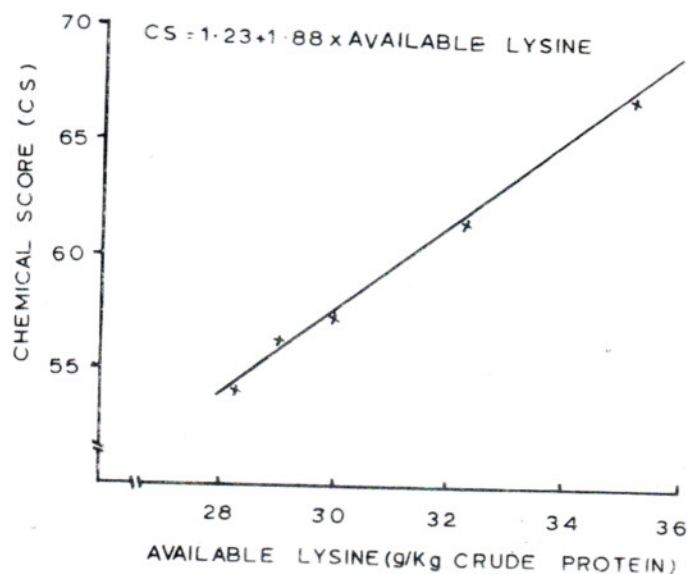


FIG 1. RELATIONSHIP OF AVAILABLE LYSINE AND CHEMICAL SCORE.

The highly significant positive correlation ($r=0.99$) between CS and the available lysine indicates that lysine is the limiting amino acid in all the cereal-legume diets. This observation is in accord with the findings of Khan and Eggum (1978, 1979) who reported lysine as the first limiting amino acid in mixed Pakistani diets, baby foods and breakfasts cereals. Our results also support those of Sarwar *et al.* (1977) who demonstrated in balance trials with rats, that supplementation of wheat with legumes exerted a negative effect on the availability of lysine but improved the availability of sulphur amino acids. In the present study legumes, contributing 15% protein, appear to be inadequate to supplement wheat supplying 85% of protein, in respect of lysine as limiting amino acid. However, a maximum protein value was obtained, with 50 : 50 combination of wheat bread and cooked lentil protein (Khan *et al.*; 1979).

The chemical determination of available lysine appears suitable for plant breeding studies and for nutritional losses of lysine in processed foods.

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