Evaluation of Blood Catalase as a Simple and Quick Index of Protein Quality

Pages with reference to book, From 266 To 268

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Abstract

The traditional methods used for evaluation of protein quality of foods involve feeding of growing animals, infants or children for periods ranging from 7 to 28 days. However, recently a claim has been made that the blood catalase activity measurement is a simple and quick alternative to these methods. The results of this study indicate that as vet there is no simple and quick index to the cumbersome biological techniques (JPMA: 32:266, 1982).

Introduction

Protein quality is normally evaluated by the use of nitrogen balance, net protein utilisation (NPU) and protein efficiency ratio (PER) techniques. These are very cumbersome and expensive and need a lot of experience to obtain reliable results. The newly developed microbiological assays are somewhat simpler but even these need from 66 to 96 hours.

Biochemical methods based on blood analysis have been introduced to measure the protein quality in recent years. Proteins as structural elements or as biocatalysts participate in every biological process and may predict its protein quality. A negative correlation between the biological value and the activities of serum arginase, ornithine carbamyl transferase and glutamic pyruvic transaminase was observed by Bergner (1977). Among the metalloenzymes, the cytochrome oxidase was found to be positively correlated with the quantity of the protein and the catalase with the quality (essential amino acid index). However, the ceruloplasmin and alkaline phosphatase showed no significant response (Kirchgessner et al., 1977).

Khan (1978) has claimed that the activity of blood catalase in the rat is highly correlated with net protein utilisation (NPU) of the diet and is given by the equation:

NPU=-4.31 + 108.1 x Blood catalase (unit/ul of blood) and that the correlation coefficient between catalase and NPU was r=0.96 and was highly significant. The present work was carried out to investigate whether this equation holds good under ail conditions by using foods having a wide range of protein quality and quantity.

Material and Methods

Seventeen different commercial foods, home level recipes and raw foods were selected for this investigation. Their nitrogen content was measured by the method described by Pellet and Young (1980). Net protein utitisa-tion operative (NPU Oper.) was also measured by the method described by these authors. Blood catalase was measured by the micro method of Bonnichen et al. (1947). The composition of the protein free diet used in the NPU experiments was as follows:-

Fat 15 percent
Potato starch 60 percent
(autoclaved)
Glucose 15 percent
Mineral vitamin 10 percent

mixture (Pfizer)
The protein content of this diet was 0. 1 percent and was taken into account in determining NPU.
The NPU experiments were carried out for a period of 15 days. A group of four weaning rats were used to assess each experi-mental diet. The animals were maintained at 30°C in an air-conditioned room. Food and water was provided at libitum and food intake was recorded. At the end of the experimental period, blood was collected from the tail of the animals for catalase determination. Blood from each dietary group was pooled for this estimation. The animals were then killed, their abdomen and skull were opened and the carcass was dried at 98°C for 48 hours in an air oven to determine the body water and body nitrogen.

Results

The blood catalase activity and the corresponding values for NPU (Oper) are shown in the accompanying table I.

Table

Blood Catalase Activity in Relation to N.P.U. Operative in Rats

Food	*Net Protein Utilization*		*Catalase Activity (umol/ml/min x10)*
	Observed	*Calculated*	
Farex Alone	63.00	52.00	10.33
Farex+Milk (80:20)	76.00	56.00	13.25
Complan	76.00	52.00	10.33
Cerelac	71.00	54.00	11.92
Ration Wheat Alone	31.00	57.00	13.96
Ration Wheat+Milk (80:20)	64.00	55.00	12.45
Whole Wheat Alone	41.00	44.25	4.90
Whole Wheat+Milk (80.20)	63.00	60.00	16.50
Bread	40.00	43.00	3.71
Bread+Milk	62.00	45.00	5.48
Dal Masoor	37.00	59.00	15.81
Potato Dried	27.32	53.00	11.84
Control	Zero	38.00	10.17
Milk Alone	80.00	39.00	13.12
Carrot Fresh	13.00	42.00	3.24
Maize	68.00	60.00	16.56
Soya Bean	34.01	40.00	16.09

It shows that the blood catalase activity holds no direct relationship to the NPU of the diet. The relationship between NPU and blood catalase arc also presented in the form of a scatter diagram in the accompanying figure.

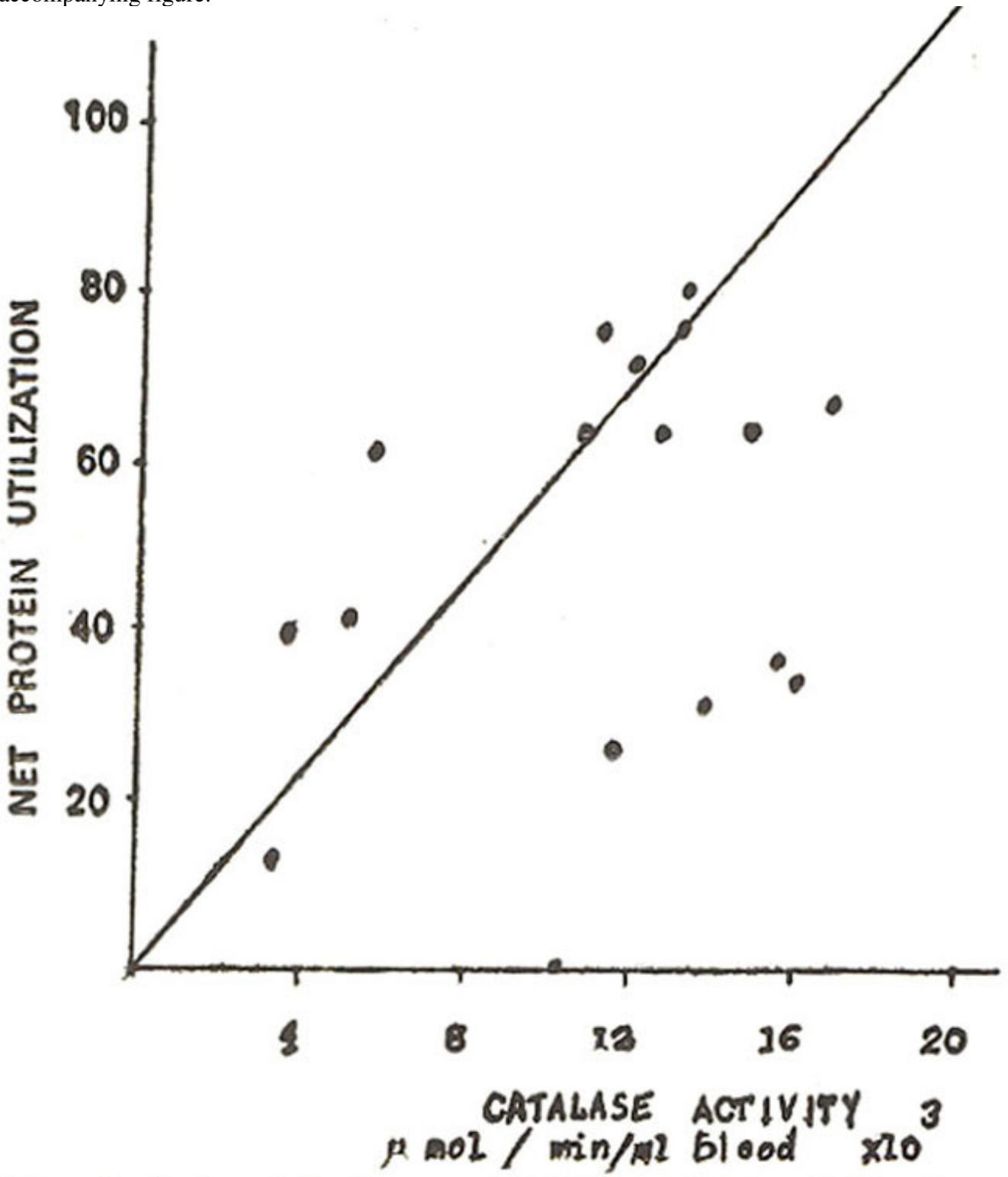

Fig. Relationship between NPU and Blood Catalase.

It is again evident that no consistent correlation emerges between NPU and blood catalase activity.

Discussion

The results of these experiments clearly show that there is no consistent correlation between blood catalase activity and NPU (Oper.) of the diet and that blood catalase measurement cannot be used as an index of protein quality. It may be mentioned here that such claims for other enzymes have been made from time to time only to be disproved later on. Stephen (1968) claimed that the activity of the urea cycle enzyme arginosucci-natelyase was reduced in female weaning rats but not in male rats. This claim was however challenged by Jeffrys and White (1975) who showed that there was no difference in the activity of the enzyme in the male and female rats.

Similarly Allianese et al. (1972) claimed that serum ribonuclease elevation was associated with negative nitrogen balance in a number of clinical situations. However, Shenkin and Bieleck (1979) have shown that in man the presence of renal or hepatic damage can also lead to elevation in serum ribonuclease and the effect of nutritional status alone may be difficult to assess. Shenkin and Bieleck (1979) have also measured serum ribonuclease and correlated it with nitrogen balance in the rat and found that the activity of this enzyme does not correlate negatively with nitrogen balance. They further suggest that serum ribonuclease concentration is probably dependent both on the weight of the animal and the rate of change in weight.

It is concluded that there is as yet no simple and reliable alternative to the cumbersome and costly net protein utilization and nitrogen balance techniques for evaluation of protein quality.

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