

# Nutritional Evaluation of Lentil (*Lens esculenta*) as Protein Supplement for Wheat Protein

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## Introduction

Dietary surveys indicate that the diet of the majority of the population in developing countries is based on cereal grains, providing a significant amount of energy as well as protein and a legume food, representing the main source of supplementary protein in these diets. Cereal grains are nutritionally characterized by low levels of total protein, deficient in lysine, but have adequate amounts of the sulphur-containing amino acids (Khan & Eggum, 1978). On the other hand, legume grains contain twice as much protein as cereal grains. This protein is a rich source of lysine although low in total sulphur-containing amino acids (Khan et al., 1978).

A good combination of cereal and legume in a mixed diet has been considered to be essential for optimum protein quality. Studies carried out by several investigators have indicated that the protein value of a mixture of legume and cereal grain is superior to that of each of these components fed individually (Bressani et al., 1962; Bressani & Elias, 1974, 1977; Khan et al., 1976; Khan et al., 1977). Adequate information on the supplementary effect of pulses, commonly consumed in Pakistan, on the protein quality of cereals is not available. In this paper the effect of different levels of cooked lentil on the protein quality of wheat as measured in rat assay has been reported.

## Materials and Methods

The experimental procedure has been described by Khan & Munira (1978). Forty-eight weanling Albino rats, 23 days old, were used for the biological evaluation of dietary protein. The rats were given stock diet (20% protein) for 7 days

and were randomly divided into groups of four rats each. The experimental diets (Table 1) containing 10% protein were randomly assigned to these groups in such a way that each diet was fed ad-libitum to two groups of rats for a period of 10 days. A protein-free diet containing: corn oil 10%, vitamin mixture 2%, mineral mixture 4%, corn starch 42% and sucrose 42% was included to measure metabolic faecal nitrogen.

Wheat and lentil were purchased from the local market. The lentil were cooked at 15 Psi for 10 min and dried by a stream of hot air at 60°C for 18 h. Wheat and cooked lentil were ground and mixed in the diets (Table 1). Moisture and nitrogen were estimated by the AOAC method. PER (g weight gain/g protein intake) was calculated from a ten day period in this study and may not be the same value as the standard value (28 days). Net protein utilisation (NPU) was estimated according to the method of Miller & Bender (1955). The true protein digestibility (TD) and biological value (BV) of the diets were calculated as follows:

TD (%)

$$= \frac{\text{N intake} - (\text{faecal N} - \text{metabolic N})}{\text{N intake}} \times 100$$

Table 1. Composition of experimental diets (%)

Ingredients	Diets				
	A	B	C	D	E
Wheat flour	100.0	75.0	50.0	25.0	—
Cooked lentil	—	10.0	20.0	30.0	40.0
Corn starch	—	15.0	30.0	45.0	60.0
Total	100.0	100.0	100.0	100.0	100.0
<i>Protein distribution (%)</i>					
Wheat flour	100.0	75.0	50.0	25.0	—
Cooked lentil	—	25.0	50.0	75.0	100.0

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Table 2. Supplementary effect of cooked lentil on the protein quality of wheat

	Wheat flour	Wheat flour-cooked lentil	Wheat flour-cooked lentil	Wheat flour-cooked lentil	Cooked lentil
Protein distribution (%)	100	75:25	50:50	25:75	100
Weight gain/group (g)	63.0	110.0	117.0	75.0	44.0
Protein efficiency ratio	1.0	2.5	2.7	1.9	1.3
True digestibility (%)	86.0	82.0	84.0	87.0	84.0
Net protein utilization (%)	48.0	59.0	66.0	51.0	46.0
Biological value (%)	56.0	72.0	79.0	59.0	55.0
Net dietary protein calorie (%)	4.8	6.5	7.3	5.5	4.9

$$BV (\%) = \frac{NPU}{TD} \times 100$$

Net dietary protein calorie percent (NDpCal%) of the diets were calculated according to Miller & Payne (1961). The data were subjected to statistical analysis by using analysis of variance technique (Snedecor, 1965).

### Results

Table 2 shows the average values for weight gain, Protein efficiency ratio, true protein digestibility, net protein utilisation, biological value and net dietary protein calorie percent.

#### Protein efficiency ratio (PER)

The average PER of the diet containing wheat protein alone was 1.0 and it improved significantly ( $P < 0.05$ ) to 2.5, 2.7 and 1.9 when 25, 50 and 75% of wheat protein was replaced by lentil protein respectively. There was no difference between the PER values of the diets having only wheat protein or lentil protein. A higher PER

(2.7) was obtained when 50% of the protein in the diet was derived from wheat and 50% from lentil.

#### True protein digestibility (TD)

The TD of wheat protein was not affected by supplementation with lentil as there was no significant difference between the values for TD of the diets having various combinations of wheat and lentil protein.

#### Net protein utilisation (NPU)

NPU increased significantly ( $P < 0.01$ ) from 48% in wheat based diet to 59 and 66% in diets supplemented with 25 and 50% lentil protein respectively. No significant improvement in NPU was observed when 75% of the dietary protein was replaced by lentil protein. The NPU of the diet containing 50% protein from wheat and 50% from lentil was the highest (Fig. 1).

#### Biological value (BV)

The BV of wheat and lentil protein was 56 and 55% respectively. The BV of the diets increased to 72, 79 and 59% when wheat and lentil proteins were mixed in ratio 75:25, 50:50 and 25:75, respectively. The level of significance was of the same order as NPU.

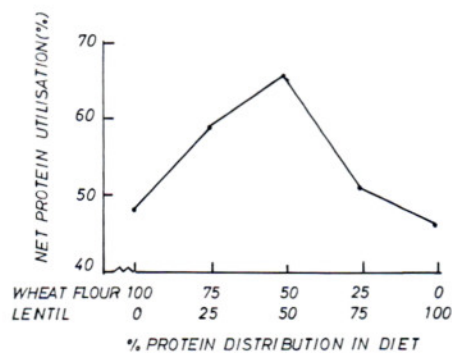
#### Net dietary protein calorie percent (NDpCal%)

The NDpCal% of the diets supplemented with different levels of lentil protein lies between 5.5 and 7.3.

### Discussion

Present results show that maximum protein value is obtained when 50% of the protein in the diet is derived from wheat and 50% from cooked lentil. These figures correspond to 50 g of wheat flour and 20 g of cooked lentil, with a ratio 2.5

Fig. 1. Net protein utilisation of various combinations of wheat flour and cooked lentil.



to 1. Similar results in a mixture of cereal and cooked bean have been reported (Bressani & Elias, 1969). However, Khan & Eggum (1978), in another work with home prepared baby food containing semolina (2 parts) and Bengal gram flour (1 part) observed higher TD (99%) and NPU (74%). It was interesting to note that a mixture of the two components in the ratio shown above, presumably supplying all the essential amino acids, has BV greater (41%) than does each component alone. In Fig. 1 lysine appears to be the main limiting amino acid when wheat provides from 50% to 100% of the protein of the diets. On the other hand, methionine may become the deficient amino acid when 75 or 100% of dietary protein are provided by cooked lentil, and resulting a low NPU of the diets. The BV of the cooked legumes has been shown to be correlated with the total sulphur amino acids (Khan et al., 1978).

According to FAO (1965), the protein allowances for different age groups in term of NDpCal% are 8.0, 7.8, 5.9, 8.4, 4.6 and 9.5 for infant, toddler, child (4-9 years), adolescent, adult and lactating mothers, respectively. All the supplemental diets in the present study have NDpCal% between 5.5-7.3 and can meet the protein requirement of children (4-9 years) and adults only. Similar results in a combination of boiled rice and cooked lentil have been reported by Khan & Eggum (1978).

### Summary

The supplementary effect of cooked lentil on the protein quality of wheat at 10% dietary protein level in weanling rats was studied. In the supplemented diet wheat supplied 75, 50 and 25% protein while the rest was provided by lentil protein. The PER, NPU, BV and NDpCal% of supplemented diets varies between 1.9-2.7, 51-66%, 59-79% and 5.5-7.3%, respectively. Highest protein quality was obtained when 50% of the protein of the diet was derived from each of the components. This mixture had BV of 79.0% and was higher (41%) than wheat (56.0%) and lentil (55.0%) when each fed alone. TD of wheat protein was not affected by supplementation. NDpCal% values indicate that supplemented diets can meet the protein requirement of children and adults.

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