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NUTRITIVE VALUE OF WHEAT PROTEIN AS INFLUENCED  
BY SUPPLEMENTATION WITH LENTIL AND FISH MEAL

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The supplementary effect of lentil and defatted fish meal on the protein quality of wheat was measured in weanling rats. In the supplemented diets wheat supplied 80 per cent protein while the rest of 20 per cent was provided by lentil or fish meal or 10 per cent from each of these. The protein efficiency ratio (PER), net protein utilization (NPU), biological value (BV) and net dietary protein calorie per cent (NDp Cal%) of supplemented diets varied between 0.9 - 2.1, 58-78 per cent, 72-96 per cent and 6.5 - 8.5 per cent, respectively. The best protein quality was obtained when 80 per cent of the protein in the diet was derived from wheat and 10 per cent each from lentil and fish meal. The NPU of this combination was 78 per cent which was 34 and 13 per cent higher than wheat-lentil and wheat-fish meal mixtures, respectively. It can meet the protein requirement of all different groups except lactating mothers as indicated by NDp Cal% value.

INTRODUCTION

Cereals constitute main staple of the Pakistani diet. According to the micro-nutrient survey of Pakistan (1978), wheat contributes 84 per cent of the total cereal intake and provides 51 and 60 per cent of the total calories and protein consumed, respectively. Wheat protein lacks the balance of essential amino acids required for its complete biological utilization (Khan and Eggum, 1979). It has been reported that the order of limiting amino acids in wheat protein is lysine, threonine and valine (Khan and Eggum, 1978 a). The consumption of pulses on the other hand is low and provides 5.3 per cent of the total intake of protein. This protein is rich in lysine although low in total sulphur containing amino acids (Khan *et al.*, 1979).

A combination of cereal and legume has been reported to meet the protein requirement of various age groups (Khan *et al.*, 1976; Khan *et al.*, 1977; Khan and Eggum, 1978 b; Khan and Eggum, 1979 a; and Khan *et al.*, 1979).

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However, NCp Cal% values indicate that the protein value of the combination of rice and lentil (Khan and Eggum, 1978 a) and wheat and lentil (Khan *et al.*, 1979) is not adequate for all different age groups and can meet only the protein requirement of adults and children (4-9 years). There is a need to improve the protein quality of the staple diet with some efficient source of protein such as fish. The present work was thus, undertaken to study the supplementary effect of lentil and fish meal (defatted) on the quality of wheat protein.

#### MATERIALS AND METHODS

The experimental procedure has been described by Khan and Munira (1978). Forty weanling Sprague Dawley rats 23 days old were used in this study. The rats were given stock diet (20 per cent protein) for 7 days and were randomly divided into groups of four rats each. The experimental diet containing corn oil 10 per cent, vitamin mixture 5 per cent, mineral mixture 5 per cent, corn starch 40 per cent and sucrose 40 per cent was used to measure metabolic faecal nitrogen.

Table 1. Percentage composition of experimental diets

Ingredients	D i e t s			
	A	B	C	D
Wheat flour (whole)	85.0	70.0	70.0	70.0
Lentil	—	9.0	—	4.5
Fish meal (defatted)	—	—	3.0	1.5
Corn starch	—	6.0	12.0	9.0
Vitamin mixture	5.0	5.0	5.0	5.0
Mineral mixture	5.0	5.0	5.0	5.0
Corn oil	5.0	5.0	5.0	5.0
<i>Protein distribution (%)</i>				
Wheat flour	100.0	80.0	80.0	80.0
Lentil	—	20.0	—	10.0
Fish meal (defatted)	—	—	20.0	10.0

Wheat flour, lentil and commercial fish meal (deffated) were purchased from the market. The moisture and nitrogen contents were estimated by the AOAC methods. Protein efficiency ratio (PER) was calculated from a ten days period in this study. This value may not be the same as the standard value calculated from 28 days period. Net protein utilization (NPU) was estimated according to the method of Miller and Bender (1955). The methods used for the calculation of true protein digestibility (TD), biological value (BV) and NDpCal% have been described by Khan (1972) and Khan and Ghafoor (1973).

### RESULTS

Table 2 shows the average values for PER, TD, NPU, BV and NDpCal%.

Table 2. Supplementary effect of lentil and fish meal on protein quality of wheat

	Wheat flour	Wheat flour: lentil	Wheat flour: fish meal	Wheat flour: lentil: fish meal
Protein distribution (%)	100	80:20	80:20	80:10:10
PER	0.7	0.9	1.3	2.1
TD (%)	83.0	80.0	82.0	81.0
NPU (%)	53.0	58.0	69.0	78.0
BV (%)	63.0	72.0	84.0	96.0
NDpCal (%)	5.5	6.5	7.8	8.5

#### Protein Efficiency Ratio

The average PER of the diet containing wheat protein alone was 0.7 and it increased to 0.9 and 1.3 when 20 per cent wheat protein was replaced by lentil and fish meal, respectively. However, it improved to 2.1 when 80 per cent of the protein in the diet was derived from wheat, 10 per cent from lentil and 10 per cent from fish meal.

#### True Protein Digestibility

The TD of wheat protein was not affected by supplementation either with lentil or fish meal or with a combination of both of these.

### Net Protein Utilization

The NPU of wheat protein was 53 per cent which improved to 58 when 20 per cent of it was replaced by lentil. A significant improvement in NPU was observed when 20 per cent protein was supplied by fish meal. This value further improved to 78 per cent when the diet containing 80 per cent protein from wheat, 10 per cent protein from lentil and 10 per cent protein from fish meal was fed to the rats.

### Biological Value

As such the BV of wheat protein was 63 per cent. It increased to 72 and 84 per cent when 20 per cent wheat protein was replaced by lentil and fish meal, respectively. The BV of the diet containing 80 per cent protein from wheat, 10 per cent each from lentil and fish meal was the highest (96%).

### Net Dietary Protein Calorie Per cent

The NDpCal% of the diets supplemented either with lentil or fish meal or with both of these lies between 6.5 and 8.5.

## DISCUSSION

Present results showed that the protein quality of wheat was improved slightly when 20 per cent wheat protein was replaced by lentil which indicated that lentil protein probably did not supply enough available lysine to supplement the wheat protein, deficit in lysine (Almas, 1979). However, the quality of wheat protein improved significantly when 20 per cent protein was replaced by that of fish meal. The highest values in this regard were obtained when 80 per cent protein from wheat and 10 per cent each from lentil and fish meal was supplied in the diet, showing the supplementary effect of fish meal. Since fish meal protein is particularly rich in two amino acids most commonly found limiting in vegetable proteins, i. e., lysine and methionine, therefore, inclusion of a small amount of this efficient source of protein in the diets helped improve the protein quality of wheat and that of the combination of wheat and lentil.

According to the Committee on Protein Requirements (FAO, 1965), the protein allowances for different age groups in terms of NDpCal% are 8.0, 7.8,

5.9, 8.4, 4.6 and 9.5 for infants, toddlers, children (4-9 years), adolescents, adults and lactating mothers, respectively. The NDpCal% of wheat supplemented with lentil is 6.5 and is suitable only for adults and children (4-9 years). These results are in line with the findings of Khan *et al.* (1979). The NDpCal% of wheat and fish meal mixture is 7.8 and can meet the protein requirement of toddlers, children (4-9 years) and adults if consumed in adequate amounts. The NDpCal% of wheat protein supplemented with lentil and fish meal is 8.5. Such a combination is suitable for all different groups except lactating mothers.

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