

NUTRITIONAL QUALITIES OF DIFFERENT WHEAT VARIETIES GROWN IN NORTH WEST FRONTIER PAKISTAN

Said Wahab^{*}, Saleem Khan^{**}, Mansoor Khan Khattak^{***}, Aurangzeb^{****},
Nazir Ahmad^{*****} and Fozia Habib^{**}

ABSTRACT

Eight wheat (*Triticum aestivum*) varieties grown in NWFP were selected for this study. These varieties were grown under identical conditions during the two consecutive crop years at Cereal Crop Research Institute, Pirsabaq Nowshera by applying similar inputs. Each year the wheat cultivars were planted during second week of November and harvested in first week of June. The collected samples were thoroughly cleaned; tempered and whole wheat flour was prepared. The samples were packaged in polyethylene bags for further studies. Results pertaining to In vitro protein digestibility of these varieties showed non-significant influence for the crop years. The wheat varieties was also found to be statistically non significant, however numerical differences were observed for the wheat varieties. The experiments were carried out on weight gain, net protein utilization, protein efficiency ratio (PER), true digestibility and biological values by feeding trials on albino rats. The weight gain due to diets prepared from different wheat varieties did not differ widely. The PER was calculated on the basis of rat growth method for a total period of 28 days. The results in Table III. indicated that crop year did not affect the protein efficiency ratio, NPU, TD and BV of different wheat varieties; however the experimental diets prepared from different wheat varieties showed significant variation for these parameter in both the crop years.

Keywords: Nutrition, NWFP, Pakistan, Wheat

INTRODUCTION

Wheat (*Triticum aestivum* L.) grain and its products are one of vital components of our daily diet. Wheat is number one food grain crop consumed directly by the humans and its production leads other food grains such as rice, maize, barley sorghum, oat and millet in the world. On global basis wheat covers maximum area as well as production as compared to other food grain crops.

Wheat is a staple food for the inhabitants of Pakistan, and contributes more than 60% of the total protein and calories requirements in the daily diet (Anonymous 1986). Wheat alone can meet all the daily requirements of thiamine and niacin whereas it can provide more than half of the total daily requirements for iron and riboflavin (Khan 1984). It is also the cheapest and principle source of carbohydrates and proteins in our daily diet. In Pakistan about 70% of the total wheat produced is utilized in the form of unleavened flat bread known as chapatti while in NWFP it is mainly used in the form of leavened bread and locally known as (Khamiri roti). The rest 30% is used for other bakery products such as bread, cookies, cakes, pastries etc. It has been an elusive task for many years to provide a precise definition as to wheat contributes quality in wheat. Keeping in view the nutritional significance of wheat in our daily diet this study was undertaken to evaluate the wheat varieties grown in NWFP for in-vitro and in-vivo protein digestibility.

MATERIALS AND METHODS

Samples Collection

Eight cultivars of wheat (*Triticum aestivum*) namely Suleman-96, Nowshera-96, Bakhtawar-92, Tatara, Pirsabaq-91, Khyber-87, Sarhad-82 and Khyber-79 were selected for this study. The wheat varieties were grown under identical conditions during two consecutive crop years i.e. 1996-97 and 1997-98 at Cereal Crop Research Institute, Pirsabaq Nowshera by applying similar inputs. Each year the wheat cultivars were planted during second week of November and harvested in first week of June. Each cultivar received fertilizers at the rate of 110kg nitrogen, 55kg phosphorus and potassium 10kg / ha with five irrigations. The samples of wheat varieties were evaluated for In-vitro and In-vivo protein digestibility.

In vitro protein digestibility

In vitro protein digestibility (IVPD) was determined by the method described by Singh *et al.* 1982. Instead of using two enzymes only single enzyme was used.

A 100 mg sample of each wheat variety was taken and 4mg of trypsin enzyme in 7.5 ml of 0.1M phosphate buffer of pH 8 was added to the samples. Then the samples were incubated at a temperature of 37°C for 24hours under shaking the reaction was terminated by adding 10% trichloro acetic acid (TAA) solution. Soluble nitrogen was separated by centrifugation for 30 minutes (approximately

^{*} Department of Food Science & Technology, N.W.F.P, Agricultural University, Peshawar - Pakistan

^{**} Department of Obstetrics & Gynaecology, Unit-A, Khyber Teaching Hospital, Peshawar - Pakistan

^{***} Department of Human Nutrition, NWFP Agricultural University, Peshawar - Pakistan

^{****} Nuclear institute for Food and Agriculture, Tarnab, Peshawar - Pakistan

^{*****} Department of Animal Nutrition, NWFP Agricultural University, Peshawar - Pakistan

10000 rpm) and the supernatant was collected for soluble nitrogen by using Kjeldahl method.

Biological evaluations

- i. The whole-wheat flour was obtained by grinding the wheat grains of each variety through Udy cyclone mill. The flour was preserved in airtight plastic containers for the preparation of experimental diet.
- ii. Hydrogenated Vegetable Oil.
- iii. Maize starch manufactured by Raffan maize products, Faisalabad was used.
- iv. Molasses was obtained from Khazana Sugar Mill Peshawar was used in the experimental diet.
- v. Vitamins and Mineral Mixture

Preparation of experimental diets

Eight experimental diets were constituted for biological evaluation. All the diets were kept iso-nitrogenous and iso caloric. All the diets contained 10% protein on dry weight basis. The nitrogen contents of the diets containing wheat flour was adjusted by using a nitrogen free diet mixture consisting maize starch, molasses, Malaysian red palm oil and vitamin mineral premix. Similarly the protein free and reference diets were also prepared. The percentage distribution of different ingredients in different experimental diets has been presented in Table I.

Experimental Procedure

Forty weanling Albino rats (21days), obtained from the animal house of Pakistan Council for Scientific and Industrial Research (PCSIR Labs) Jamrud Road, Peshawar were brought to the animal house of NIFA and fed on the basal diet for one week. The room temperature was maintained $28 \pm 2^{\circ}\text{C}$. The rats were randomly divided into 10 groups of 4 rats each and weighed. One group was fed on protein free diet (PFD) and one was on reference diet while 8 groups were kept on experimental diets. Each group of 4 rats was separately kept in wire screen mesh bottom; underneath each cage meal tray covered with a sheet of filter paper was placed. The diets were randomly assigned to each group. Water and food were given *ad-libitum* for 28 days. Composite weight of each group was recorded on daily basis with electronic top loading balance. At the end of 28th days faecal material was collected and dried at 105°C till to a constant weight and stored in polyethylene bags for nitrogen estimation. The spilt food from each cage was also dried and weighed. At the end of the experiment, rats were killed by chloroform anaesthesia. The skull and abdominal cavities were opened and whole body was dried in oven at 105°C till to a constant weight. The dried carcass was run through electronic grinder and stored for nitrogen estimation. The nitrogen contents of body, faeces and diets were determined. The experiment was

repeated adopting strictly the same experimental procedure and conditions. The following parameters were studied.

- (i) Net protein utilization (NPU) of each experimental diet was calculated by using the following formula described by Miller and Bender (1955)

$$\text{NPU} = \frac{\text{B} - (\text{Bk} - \text{Ik}) \times 100}{\text{I}}$$

Where

B = Total body nitrogen of rats on test free diet.

Bk = Total body nitrogen of rats on protein free diet.

I = Nitrogen intakes of rats on test diet.

Ik = Nitrogen intakes of rats on protein free diet.

- (ii) True digestibility (TD) was determined using the formula of Miller and Bender (1955)

$$\text{TD\%} = \frac{\text{I} - (\text{F} - \text{Fk}) \times 100}{\text{I}}$$

Where

I = Nitrogen intakes of rats on test diet.

F = Faecal nitrogen of rats on test diet.

Fk = Faecal nitrogen of rats on protein free diet.

- (iii) Biological Value (BV) was calculated indirectly by using the formula.

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

- (iv) Protein efficiency ratio (PER)

$$\text{PER} = \frac{\text{Total weight gain in (g)}}{\text{Total protein intake in (g)}}$$

STATISTICAL ANALYSIS

Analysis of variance have been carried out on the data obtained from this study repeatedly for two consecutive crop years following the method described by Steel and Torrie (1997).

RESULT AND DISCUSSION

In-vitro protein digestibility (IVPD) of different wheat varieties

The statistical results pertaining to the analysis of variance showed that in vitro protein digestibility of different whole wheat flours was not significantly affected due to differences in crop years. The wheat varieties and interaction between crop years and wheat varieties were also found to be statistically non significant for this trait Table 2. The IVPD for the whole wheat flour was higher in wheat varieties grown during the crop year 1996-97, than the wheat grown during 1997-98. The in-vitro protein digestibility of the whole wheat flour of different wheat varieties ranged from 82.30 to 88.62% and 82.24 to 88.47% for the crop year 1996-97 and 1997-98, respectively (Table 2). The highest in- vitro protein digestibility was got in the flour of the wheat variety Nowshera 96 while it was lowest in variety Khyber 87 grown during the crop year 1996-97. The highest value for IVPD 88.47% was obtained in the flour of the wheat variety Khyber 79 followed by the wheat variety

Nowshera 96, while the lowest in vitro protein digestibility 82.24% was recorded for the wheat variety Sarhad 82 grown during the crop year 1997-98.

When the data were averaged across the years the wheat variety Nowshera 96 got the maximum value of IVPD i.e. 88.14% while the lowest 82.38% IVPD value was exhibited by the flour of Khyber 87 when the data of years were pooled.

Nutritional quality of some wheat varieties grown in NWFP

Nutritional quality of wheat varieties grown in NWFP was evaluated by conducting feeding trials on albino rats in the animal house of Nuclear Institute for Food and Agriculture (NIFA), Peshawar. The experiments were carried out on weight gain, net protein utilization, protein efficiency ratio, True digestibility and biological values. The results obtained from nutritional assays are given in Table 3 discussed as under.

Weight Gain

The weight gain due to diets prepared from different wheat varieties did not differ widely. The highest weight gain was observed for experimental diet prepared from Bakhtawar 92 in both the crop years. The lowest weight gain was recorded in the rat groups fed on diet prepared from Nowshera 96 in both the crop years. exhibited the highest weight gain by the experimental diet prepared from the wheat varieties. The weight gain also ranged from 9.25 to 12.0 gram/ rat and 9.3 to 12.05 gram in the diets prepared from wheat varieties grown during the crop year 1996-97 and 1997-98 respectively. The experimental diets prepared from the wheat varieties Pirsabaq 91, Khyber 87, Khyber 79 and Tatara showed the highest weight gain as compared to Nowshera 96, Sarhad 82 and Suliman 96 grown during the crop year 1997-98. The wheat grown during the crop year 1996-97 Bakhtawar 92, Pirsabaq 91, Khyber 87 and Khyber 79 while the lowest values were recorded for the experimental diets from the wheat varieties Nowshera 96, Sarhad 82 Suliman 96 and Tatara with respect to weight gain. Siddiq (1985) also showed that weight gain/ rat for wheat flour was 9.25g.

Protein Efficiency Ratio (PER)

The PER was calculated on the basis of rat growth method for a total period of 28 days. The results in Table indicated that crop year did not affect the protein efficiency ratio of different wheat varieties; however the experimental diets prepared from different wheat varieties showed significant variation for this parameter in both the crop years. The PER ranged from 1.46 to 1.81 during the crop year 1996-97. The highest PER during the crop year 1996-97 was attained by the experimental diet prepared from wheat variety Bakhtawar 92, while

the lowest PER value was exhibited by the experimental diet prepared from Nowshera 96 in both the crop years.

Net Protein Utilization

The data regarding NPU ranged from 42.33 to 45.76 and 42.38 to 45.57 among the experimental diets prepared from wheat varieties grown during the crop year 1996-97 and 1997-98, respectively. The crop year did not affect the NPU however, the experimental diets prepared from different wheat varieties in both the crop years showed significant variation. The highest NPU was recorded in the experimental diet prepared from wheat variety Tatara during the crop year 1996-97, while the lowest value was obtained in the experimental diet prepared from Khyber 79. During the crop year 1997-98 the maximum NPU was obtained for the diet prepared from wheat variety Nowshera 96 while the lowest value was yielded by the experimental diet prepared from Khyber 79.

True Digestibility (TD%)

It is evident from results regarding true digestibility that crop years did not affect the true digestibility of different wheat varieties while all the experimental diets prepared from different wheat varieties showed significant variation in both the crop years. The mean TD values were 85.77 and 86.02% for diets prepared from wheat grown during the crop years 1996-97 and 1997-98, respectively. The wheat variety Nowshera 96 showed better TD in both the crop years. The lowest TD was recorded in the wheat variety Khyber 79 during both the crop years. It may be concluded from the results of this study that the newly evolved wheat varieties are superior in protein digestibility as compared to the old varieties.

Biological Value

The results indicated that mean biological values were not affected by the crop years. However all the experimental diets prepared from different wheat varieties were significantly different with regard to biological values for both the crop years. The mean BV for the crop years 1996-97 and 1997-98 was 51.38 and 51.25 respectively. During the crop year 1996-97 and 1997-98 the maximum value for BV was attained by the experimental diet prepared from the flour of Bakhtawar 92, while the lowest value for BV was obtained for the wheat variety Khyber 79 grown during the crop year 1996-97 and the lowest BV was obtained from the experimental diet prepared from Nowshera 96 grown during 1997-98. In the present investigation the new wheat varieties like Bakhtawar 92, Tatara and Suliman 96 were observed to be fairly superior in nutritional quality as compared to the old wheat

varieties such as Khyber 79, Sarhad 82, and Pirsabaq 91.

Eight wheat varieties were investigated for IVPD and results obtained from the study are in line with the findings of Ijaz *et al.* (2001) who reported that in vitro protein digestibility of wheat varieties ranged from 84.26 to 88.56% and 83.31 to 89.99% during the crop year 1995-96 and 1996-97 respectively. Chitra *et al.* (1995) analyzed several genotypes of chickpea, pigeon peas, urd bean, mung bean and soybean for in vitro protein digestibility. The in vitro protein digestibility of pigeon pea and chickpea genotypes varied from 60.4 to 74.4 and 65.3 to 79.4% respectively. The in vitro protein digestibility of genotypes of mung bean, urd bean and soybean ranged from 67.2 to 72.2, 55.7 to 63.3 and 62.7 to 71.6% respectively. They further found significant negative correlation between phytic acid and in vitro protein digestibility of these genotypes.

There are many factors, which affect the protein digestibility. Lysine is one of the major factors that have a significant affect on the nutritional quality of wheat. These differences in the IVPD may be ascribed to the lower level of lysine in the tested wheat varieties in the present study. It is referred from the results that the wheat varieties possessing higher in vitro protein digestibility may be used as a genetic material for the development of new wheat varieties with better lysine content and improved nutritional quality.

The results regarding weight gain are in line with the findings of Ahmed *et al.* (1981) who reported variation for experimental diets between some old and new wheat varieties. The average weight gain/rat ranged from 9.13 to 14.0 gram.

The results in the present case are in agreement with the results of Ahmad *et al.* (1981) who calculated the PER values of different wheat varieties viz, C 273, C 591, LU 26, Blue Silver,

Lyalpur 73, Sandal and SA 75 which were 1.82, 1.39, 2.02, 1.94, 2.12, 1.91 and 1.78 respectively. Siddiq (1985) also reported that whole flour bread have PER value 1.45, while the wheat flour supplemented with chick pea flour 5, 10, 15 and 20 % have PER value 1.76, 1.86, 1.92 and 1.96, respectively.

These results are supported by the findings of Ijaz *et al.* (2001) who reported non significant affect of the crop year on this trait. They further reported that protein digestibility ranged from 84.26 to 88.56% and 83.31 to 89.99% during the crop year 1995-96 and 1996-97 respectively. Siddiq (1985) also reported 90% TD of whole wheat bread. Khan and Eggum (1979) reported 96% TD for wheat protein. Miladi *et al.* (1972) observed that TD of whole wheat was 91%. Ahmad *et al.* (1981) studied nutritional quality of Pakistani wheat varieties and found that TD varied from 83.51 to 89.55% which is fully in agreement with the present results. These findings are also in concordance with the results of Ahmed *et al.* (1981) who reported that BV ranged from 51.85 to 72.45% for some old and new wheat varieties.

CONCLUSION

It is concluded from the present investigation regarding nutritional quality parameters were not significantly affected by the crop years, however, the experimental diets prepared from different wheat varieties significantly affected nutritional quality parameters. The interaction of crop years with wheat varieties were found non significant for these parameters.

As all the wheat varieties were significantly different with regard to nutritional quality parameters. It is suggested that the wheat varieties possessing highest biological value is recommended for wheat breeding programme to produce the new wheat varieties with better nutritional qualities.

Table I: Preparation of experimental diets

S.No	Variety	Wheat Flour	Molasses	Oil	Premix	Corn Starch	Total
1	Nowshera 96	76.69	3.0	3.0	1.5	15.81	100
2	Suliman 96	78.31	3.0	3.0	1.5	14.19	100
3	Bakhtawar92	77.70	3.0	3.0	1.5	14.80	100
4	Tatara	82.78	3.0	3.0	1.5	9.72	100
5	Pirsabaq91	80.32	3.0	3.0	1.5	12.18	100
6	Khyber87	79.30	3.0	3.0	1.5	13.20	100
7	Sarhad82	82.44	3.0	3.0	1.5	10.06	100
8	Khyber79	87.03	3.0	3.0	1.5	5.47	100

Table II: In-vitro protein digestibility (%IVPD) of whole wheat flour

Varieties	%IVPD 1996-97	%IVPD 1997-98	Mean
Nowshera96	88.62	87.65	88.14
Suliman 96	86.67	85.51	86.07
Bakhtawar 92	88.53	87.60	88.07
Tatara	86.42	87.14	86.78
Pirsabaq 91	86.92	86.48	86.70
Khyber 87	82.30	82.46	82.38
Sarhad 82	84.97	82.24	83.61
Khyber 79	84.03	88.47	86.25
Mean	86.06	85.94	

Table III: Nutritional quality parameters and biological value of different wheat varieties.

Experimental diet	Wt g/g in (g)			NPU			PER			TD (%)			BV (%)		
	1996-97	1997-98	Mean	1996-97	1997-98	Mean	1996-97	1997-98	Mean	1996-97	1997-98	Mean	1996-97	1997-98	Mean
Now 96	37.00	37.36	37.18e	45.25	45.57	45.41ab	1.46	1.46	1.46e	89.63	90.95	90.29a	50.49	50.10	50.29c
S 96	44.00	44.40	44.20d	44.19	44.34	44.27c	1.69	1.72	1.70d	85.06	85.36	85.21cd	51.95	51.78	51.86b
B 92	48.00	48.20	48.10a	44.16	45.00	44.58bc	1.81	1.80	1.81a	85.34	85.07	85.20cd	52.92	52.27	52.59a
T	45.00	46.10	45.55c	45.76	45.51	45.63a	1.72	1.76	1.74bc	87.35	87.12	87.23b	52.39	52.24	52.31a
P 91	47.00	47.30	47.15ab	44.24	44.14	44.19c	1.75	1.77	1.76b	85.42	85.04	85.23c	51.79	51.89	51.84b
K 87	46.00	46.34	46.17bc	42.49	42.38	42.44d	1.74	1.73	1.73c	84.03	84.19	84.11de	50.57	50.34	50.45c
S 82	44.00	44.05	44.03d	43.14	43.01	43.08d	1.69	1.68	1.69d	85.39	84.52	84.96cde	50.52	50.29	50.40c
K 79	46.00	46.20	46.10bc	42.33	42.72	42.53d	1.74	1.73	1.74c	83.95	83.90	83.92e	50.41	50.91	50.66c
Mean	44.63a	45.00a		43.95a	44.08a		1.70a	1.71a		85.77a	85.76a				

Mean sharing the same letters in their respective categories are not significantly different.

REFERENCES

- Ahmad, M.R., H.A.Naseem, and M.S. Hamdard. 1981. Nutritional quality of old and new improved varieties of wheat. Pak. J. Agric. Res. 2 (3): 147-151.
- Anonymous. 1986. Some dimensions of rural food poverty with special emphasis on nutritional status and its improvement. Final report, German Agro Action Project, Univ. Agric. Faisalabad, Pakistan.
- Chitra, U., V.Vimala, U. Singh and P. Geervani . 1995. Variability in phytic acid content and protein digestibility of grain legumes. Plant Foods for Human Nutrition. 47(2): 163-172.
- Ijaz, A., F.M. Anjum, and M.S. Butt. 2001. Quality characteristics of wheat varieties grown in Pakistan from 1933 to 1996. Pak. J. Food Sci. 11 (1-4): 1-8.
- Khan, M.A. 1984. Nutritional attributes of wheat. Progressive Farming 4: 23-26.
- Khan, M.A. and B.O. Eggum. 1979. Effect of home and industrial processing on protein quality of baby foods and breakfast cereals. J. Sci Food Agric. 30: 369-376.
- Miladi, S., D.M. Hegsted, R.M. Sunders, and G.O. Kohler. 1972. The relative nutritive value, Amino acid content, and the digestibility of the proteins of wheat milling fractions. Cereal Chem. 49: 119-127.
- Miller, D.S. and A.E. Bender. 1955. The determination of the net utilization of proteins by a shortened method. Brit. J. Nutrition. 91: 382-388.

- Siddiq, M. 1985. Nutritional and organoleptic evaluation of wheat bread supplemented with chickpea flour. M.Sc. Thesis Department of Agric. Chemistry and Human Nutrition. NWFP, Agric. Univ. Peshawar, Pakistan.
- Singh, U., M.S. Kherdekar, and R. Jambunathan. 1982. Studies on Desi and Kabuli Chickpea Cultivars. The level of amylase inhibitors, level of oligosaccharide and in vitro starch digestibility J. Food Sci. 47: 510.
- Steel, R.G.D. and J.H. Torrie. 1997. Principles and Procedure of Statistics. Mc Graw Hill Book Co. New York.