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Chemical Composition of Three Wheat (*Triticum aestivum* L.) Varieties as Affected by NPK Doses

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ABSTRACT

Three wheat varieties/lines (V-94091, V-94105 and Inqulab-91) were selected from Wheat Research Institute, Faisalabad and their response to NPK fertilizers was evaluated. Chemical characteristics like protein, moisture, ash, fat and fiber contents of straight grade flour of wheat varieties were determined. The results revealed that the moisture absorption by wheat flour increased by increasing the fertilizer doses. The data showed that fertilizer doses significantly affect the ash and protein contents of all varieties/lines and with increasing fertilizer rates, the crude protein and ash contents also increased. Fat and fiber contents of all wheat varieties remained unaffected by fertilizer doses.

Key Words: Composition; Wheat; Varieties; NPK; Pakistan

INTRODUCTION

Wheat (*Triticum aestivum* L.) ranks 1st with respect to area and production among the other food grain crops on global basis. The fertilizer plays a significant role towards the enhancement of yield per unit area of all crops and wheat is no exception to it. In addition to grain yield, the fertilizers also have an impact on the quality of grain. The production of bread quality wheat is possible through correct fertilizer treatment (Anjum, 1991).

The wheat quality is affected by genotype and environment (Loffler & Busch, 1982), fertilizer treatments and post harvest conditions (Stewart, 1984). Nitrogen significantly affected the protein contents and other quality characteristics such as loaf volume, grain and texture score of bread (McNeal *et al.*, 1971; Gooding & Davies, 1997). Kent (1983) reported that the variation in protein content has been found to range from 6 to 12% among the different wheat varieties depending on growing and climatic conditions. An improvement in baking quality with an increase in the protein content of grain has been reported (Brandlard & Dardevest, 1985), therefore, for bread production wheat should have a grain protein concentration ranging between 115 and 150 g kg^{-1} (Canada Grain Council, 1989).

This paper describes the effect of fertilizer doses on the chemical composition of three wheat varieties.

MATERIALS AND METHODS

Three genotypes of wheat were selected from Wheat Research Institute, Faisalabad and were grown during 1999-2000 to assess the effect of fertilizer doses on chemical characteristics. Five fertilizer doses were applied to wheat varieties (Table I). The sources of NPK were urea, single super phosphate and sulphate of potash. Nitrogen was applied in two splits while all other fertilizers were applied at sowing. All the genotypes were sown in lines spacing 15 cm apart and plots size was 15 x 30 feet. The trial was laid out in split plot design keeping fertilizer levels as main and varieties as sub-plots. Two kg grains from each variety were collected after threshing and were subjected to tempering and milling in the laboratories of Department of Food Technology, University of Agriculture, Faisalabad.

Milling of wheat. The grains of each wheat genotypes were milled to get straight grade flour. One kilogram sample of each wheat variety/line was tempered to 16% moisture level and allowed to stand for 24 h at room temperature in a closed container in order to equilibrate moisture in the grain. The water required to temper the grains was computed according to method No. 26-95. given in AACC (1983) as follows:

Table I. Fertilizer treatments for wheat genotypes, Inqulab-91, V-94105 and V-94091

Treatment	Fertilizer doses (kg ha^{-1})		
	N	P	K
T1	0	0	0
T2	50	50	0
T3	75	75	0
T4	100	100	50
T5	175	125	50

$$\text{Weight of water to be added} = \frac{100 - OM}{100 - DM} - 1 \times \text{weight of sample}$$

Where, OM= original moisture, DM= desired moisture

The tempered wheat grains of each wheat variety/line were milled through Quadrumate Senior Mill (Bass, 1988) to get straight grade flour by blending reduction and break flour mill streams. The milling of wheat grain samples was

carried out by following the instructions as given by Williams *et al.* (1986).

Chemical analysis of straight grade flour

Moisture and ash content (%). The moisture content of each wheat sample was estimated by taking 3 g sample and drying in an air forced draft oven at 105±5°C till a constant weight was obtained (AACC, 1983). The moisture content was calculated according to the expression given below:

$$\text{Moisture contents (\%)} = \frac{\text{WOS} - \text{WDS} \times 100}{\text{WDS}}$$

Where, WOS= weight of original sample and WDS= weight of dried sample

Ash contents were determined by taking 3 g flour sample in a tarred crucible and charred on a flame until it turned black and incinerated in a muffle furnace at 550°C for 5-6 h or till no black spot appeared and grey ashes (AACC, 1983). The ash content in each sample was calculated according to the following formula:

$$\text{Ash (\%)} = \frac{\text{Weight of ash} \times 100}{\text{Weight of sample}}$$

Protein, fat and fiber content (%). The percentage of nitrogen in each wheat flour sample was determined by using Kjeldahl's method (AACC, 1983). A sample was first digested in Kjeldahl's flask containing 30 mL concentrated H_2SO_4 in the presence of 5 g digestion mixture [K_2SO_4+$CuSO_4$+$FeSO_4$ (90:10:1)] till digested content attained transparent color. Volume of the cooled digested sample was made up to 250 mL and then distillation was carried out in Kjeldahl's distillation apparatus by using 10 mL diluted digested sample and 10 mL 40% NaOH solution. Ammonia liberated was collected in 10 mL of 2% boric acid solution using methyl red as an indicator. The nitrogen collected in boric acid solution was estimated by titration against 0.1N H_2SO_4 till end point. Nitrogen percentage was calculated by using following equation.

1 mL of 0.1 N H_2SO_4 = 0.0014 g of nitrogen

Protein percentage of wheat flour was calculated by:

% Crude protein = % N x 5.7

The crude fat content was determined by taking 3 g moisture free flour sample using petroleum ether as a solvent in a Soxhlet Apparatus for 2 to 3 h according to the instructions of the manufacturers and the procedure given in AACC (1983).

$$\text{Crude Fat \%} = \frac{\text{Weight of fat (g)}}{\text{Weight of sample (g)}} \times 100$$

The crude fiber was estimated by taking 1 g moisture and fat free flour sample and digested first with 1.25% H_2SO_4 and then with 1.25% NaOH solution. The fiber percentage was calculated after drying (AACC, 1983). The crude fiber was calculated as per expression given below:

$$\text{Crude Fiber \%} = \frac{\text{Weight loss on ignition (g)}}{\text{Weight of sample (g)}} \times 100$$

Data were analyzed according to the procedure described by Steel & Torrie (1980).

RESULTS AND DISCUSSION

Moisture and ash contents (%). By increasing the fertilizer doses, the moisture absorption by wheat flour increased and in Inqulab-91 maximum moisture content (13.9%) was obtained from highest fertilizer doses (Table II). While lowest moisture contents (12%) was observed at control. It ranged from 12.0 to 13.9% and statistically showed the significant effect of fertilizer doses on moisture content of Inqulab-91. Similarly, fertilizer doses significantly affected the moisture content of V-94091 and V-94105 but exhibited less effect than Inqulab-91. The moisture content for straight grade flour did not differ due to tempering in most of the wheat varieties at the same moisture level i.e. 16%. The results of present study are comparable with Davies *et al.* (1981) and Butt (1997).

The ash content ranged from 0.37 to 0.47%. The data

Table II. Effect of fertilizer doses on moisture contents (%) of different wheat varieties.

Treatments (kgha^{-1})			Inqulab 91	V-94091	V-94105	Mean
N	P	K				
0	0	0	12.20d	12.00b	11.82 ab	12.0B
50	50	0	13.40 c	13.76 ab	13.36 ab	13.5 AB
75	50	0	13.60 bc	13.61 ab	13.45 ab	13.8 A
100	100	50	13.90 a	13.91 a	13.80 a	13.9 A
175	125	50	13.50 A	13.40 A	13.15 B	

Mean values carrying the same letter in a column are not significantly different from each other at P<0.05

(Table III) showed that fertilizer doses significantly increased the ash contents of all variety/lines. All the varieties/lines exhibited lowest ash contents at zero fertilizer level. The flour of Inqulab-91 yielded significantly the highest ash content followed by V-94105 and V-91091 and both the latter wheat showed non-significant difference with each other.

Protein fat and fiber contents (%). It is obvious from the

Table III. Effect of fertilizer doses on ash contents (%) of three wheat varieties

Treatments kgha^{-1}			Inqulab-91	V-94105	V-94105	Mean
N	P	K				
0	0	0	0.38 b	0.36 c	0.38 c	0.37 D
50	50	0	0.41 ab	0.40 bc	0.38 bc	0.40 CD
75	75	0	0.45 a	0.41 bc	0.43 abc	0.43 BC
100	100	50	0.45 a	0.44 ab	0.45 ab	0.45 AB
175	125	50	0.47 a	0.48 a	0.46 a	0.47 A
Mean			0.43 A	0.42 A	0.42 A	

Mean values carrying the same letter in a column are not significantly different from each other at P< 0.05

results (Table IV) that the protein content varied from 11.0 to 12.82% among flour of different wheat varieties.

Table IV. Effect of fertilizer doses on Protein Contents (%) of three wheat varieties

Treatment (kgha^{-1})			Inqulab 91	V-94091	V-94105	Mean
N	P	K				
0	0	0	11.08 e	10.65 d	11.50 b	11.08 D
50	50	0	11.50 d	10.54 e	10.95 c	11.00 E
75	75	0	11.58 c	11.63 b	10.81 d	11.34 C
100	100	50	11.86 b	11.70 a	13.90 a	12.82 A
175	125	50	13.00 a	11.34 c	11.94 a	11.23 B
	Mean		11.95 A	11.17 C	11.42 B	

Mean values carrying the same letter in a column are not significantly different from each other at P< 0.05

Significantly the highest protein content was observed in flour of Inqulab-91 followed by V-94091 and V-94105 with non-significant differences among each other. Inqulab-91 accumulated highest protein contents (13.0%) at NPK level of 175-125-50 kg ha^{-1} while lowest was found at zero fertilizer level. V-94091 had the lowest protein contents (10.65%) at control and highest at NPK level of 100-100-50 kg ha^{-1}. Similar kind of trend was also noted in V-94105.

Crude fat contents of all the varieties/lines ranged from 0.82 to 0.94%. The results (Table V) revealed that all the variety/lines showed the non-significant response of fertilizer doses for its fat content. The data revealed that all the varieties/lines exhibited non-significant response to fertilizer application on flour crude fiber content (Table VI) and it ranged from 0.12 to 0.14%.

CONCLUSION

It is concluded that fertilizer doses has significant effect on protein, ash and moisture contents of all the three wheat varieties, while fat and fiber contents remained non-significant to fertilizer doses.

Table V. Effect of fertilizer doses on fat contents (%) in three wheat varieties

Treatments (kgha^{-1})			Inqulab-91	V-94091	V-94105	Mean
N	P	K				
0	0	0	.82NS	0.82NS	0.82NS	0.82NS
50	50	0	0.85	0.83	0.83	0.84
75	75	0	0.86	0.85	0.84	0.85
100	100	50	0.89	0.88	0.88	0.88
175	125	50	0.92	0.91	0.92	0.92
	Mean		0.87 A	0.86 A	0.86 A	

Mean values carrying the same letter in a column are not significantly different from each other at P< 0.05

Table VI. Effect of fertilizer doses on fiber contents (%) in three wheat varieties

Treatments (kgha^{-1})			Inqulab91	V-94091	V-94105	Mean
N	P	K				
0	0	0	0.11NS	0.13NS	0.12NS	0.12NS
50	50	0	0.12	0.15	0.12	0.13
75	75	0	0.14	0.15	0.14	0.14
100	100	50	0.12	0.14	0.16	0.14
175	125	50	0.13	0.13	0.15	0.14
	Mean		0.13 A	0.14 A	0.13 A	

Mean values carrying the same letter in a column are not significantly different from each other at P< 0.05

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