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Physicochemical Characteristics of Wheat Varieties Growing in the Same and Different Ecological Regions of Pakistan

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Abstract: Wheat grains a source of our daily food were obtained from the different ecological regions of Pakistan. These fifteen varieties namely Fakhr-e-Sarhad, Bakhtawar-92, Chudry-97, Gandam-2002, Wafaq-01, Bhakkar-01, Inqilab-91, Tatara, Ghaznawy, Saleem-2000, Watan, Oqab, Tuf, Zakht and Gandam-711 were evaluated for their physicochemical characteristics and minerals contents. Six of these varieties, Fakhr-e-Sarhad, Oqab, Tuf, Zakht, Watan and Inqilab-91 growing in the same ecological conditions in district Chitral were selected in order to show the effect of same ecological conditions on the overall productivity of wheat varieties in term of physicochemical and minerals contents. Results reveal that same variety growing in district Chitral shows good productivity than the rest of varieties growing in different ecological conditions.

Key words: Wheat varieties, physicochemical characteristics, elemental composition

INTRODUCTION

Wheat (*Triticum aestivum*) is the most widely cultivated of all cereals. It is grown in all temperate countries and in the most of subtropical countries of the world. In Pakistan it is the basic dietary requirement. It provides proteins and calories of 50 and 60%, respectively. Wheat constitutes about 80% of total dietary intake (Bostan and Naeem, 2002). The productivity of wheat is related to its micronutrient composition, protein and starch content and physicochemical characteristics. Micronutrients especially sodium and potassium are very important in our daily food. These nutrients must be supplied to the body through diet. In most part of the world wheat is source of common day food. Micronutrients are thus supplied in this form. These micronutrients also play important role in growth and development of wheat seed and plant itself.

Wheat is the major cereal crop occupying on well-known place in economy of our country (Chowdhry *et al*., 1998). Wheat is grown in all of the provinces of Pakistan. Punjab is its major producer and supplier of wheat (7.5 million tones during, 1984-85). Sindh is self sufficient (2.1 million tones) while NWFP and Baluchistan are deficit by 0.9 and 0.11 million tones, respectively and mostly meet their demand from Punjab province (Khan and Kulachi, 2002). The wheat productivity in these areas is especially dependent on soil composition, environmental and stress factors including temperature, drought, humidity etc. Pakistan is a region of a very diverse ecology ranging from a very hot to cold environment. Different Wheat variety or same variety in different ecologies is very important in term of its productivity measurement of a country. The present study is aimed to analyze the physicochemical characteristics and micronutrient status of different wheat varieties growing in different and same ecological regions of Pakistan.

MATERIALS AND METHODS

Different ecological regions of Pakistan were selected for collection of wheat grains. The Wheat varieties were collected and stored in the labeled Glass bottle to ensure safety, in the Department of Biotechnology, University of Malakand, for analysis. Statistical analysis were also carried out with data obtained.

Micronutrients composition: Thirty grains was collected in a flask and add 30 mL double distilled water. The flasks were occasionally shacked for 1 h. Minerals composition (Na^+ and K^+) of wheat varieties was determined with the help of Flame Photometer (model Jenway PFP 7). The leachate obtained after one hour imbibitions was used for this determination. The instrument was standardized by standard potassium and sodium solutions, respectively (Ashraf and Hussain, 1998).

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Moisture contents: Moisture contents were determined according to the method used by Khan and Kulachi (2002). Moisture contents of 100 grains wheat sample were determined with the help of Electric Oven. For this purpose initial weight of sample was taken and then placed in oven at 72°C for 48 h and again weight was taken. The moisture content was determined according to the formula:

Moisture Contents = Initial Wt. - Final Wt.

Electrical conductivity: Thirty wheat seed of each variety were placed in 30 mL double distilled water in Petri dishes at 18°C with occasional shaking for 1 h. The electrical conductivity after each 1 h with a pre calibrated conductivity meter was measured.

Thousand Grain Mass (TGM): Thousand Grain Weight (TGM) are very important parameter to study the net productivity of wheat. After calculation of moisture content per single grain was calculated. Thousand Grain Weight (TGM) were determined according to the following formula:

$$\text{Dry TGM} = \frac{10 \times M\ (100 - H)}{N}$$

M = Wt. of Wheat Sample
H = Moisture of the grains
N = Number of grains in sample

RESULTS

Micronutrients composition: The data regarding mineral nutrients of wheat varieties growing at different ecological condition are presented in Table 1. An average Potassium content of Watan variety is 1.466 ppm per single grain; Gandam-711 is placed on second position containing 1.390 ppm. The lowest level of potassium is present in Bakhtawar- 92 with 0.646 ppm. Sodium content of Chudry-97 is 7.4 ppm, Bhakkar-01 with 6.5; Inqilab-91 on third position with 6.3 ppm.

Micronutrient composition of wheat varieties growing in the same ecological conditions of district Chitral is given in Table 2. Tuf and Oqab shows a high level of potassium and K^+/Na^+ ratio with the value of 18.3529 and 15.25, respectively Fakhre Sarhad shows the lowest level of K^+/Na^+ and highest level of sodium.

Moisture contents: Moisture contents were measured in order to know the level of water contents of wheat plant, essential in term of productivity. Data regarding moisture contents of different wheat varieties growing at different ecological region of Pakistan is given in Table 3. The wheat variety Wafaq-01 contains highest of moisture with 3.547 g per 1000 grains; Oqab has 3.545 g. The lowest moisture content is present in Zakht with 1.870 g per 1000 grains.

Moisture contents of wheat variety of district chitral are presented in Table 4. Oqab and Fakhr-e-sarhad varieties have 3.45 and 3.524 g per 1000 grains, respectively. The lowest level is present in Tuf and Zakht with 2.583 and 1.87 g.

Electrical conductivity: Electrical conductivity represents the number of ions of minerals comes out of the seed during Imbibition. Data regarding EC after each 10 min of Imbibition is given in Table 5. Data shows that EC value increases after each interval of 10 min. Oqab, Tuf and Zakht variety were place on the top having 96-129.2, 104.2-125.7 and 100.3-123.4 μS, respectively. Fakhr-e-Sarhad, Tatara and Bakhtawar-92 shows less level of 28.1-42.8, 24.6-39.8 and 21.0-33 μS.

Data of different wheat varieties growing in the same ecological region of district Chitral is presented in Table 6. Watan and Oqab shows high level of conductivity after each 10 min interval, with a value

Table 1: Minerals nutrients contents of different wheat varieties growing at different ecological regions of Pakistan

	Sodium (ppm)		Potassium (ppm)		
Wheat variety	30 grains	Single grain*	30 grains	Single grain	K^+/Na^+ ratio
Watan	5.0	0.166	44.0	1.466	8.8000
Gandam-711	6.0	0.200	41.7	1.390	6.9500
Inqilab -91	6.3	0.210	39.5	1.316	6.2698
Oqab	2.4	0.080	36.6	1.220	15.250
Chudry-97	7.4	0.246	33.6	1.120	4.5405
Wafaq-01	6.2	0.206	31.3	1.043	5.0483
Tuf	1.7	0.056	31.2	1.040	18.3529
Ghaznawy	5.9	0.196	30.4	1.013	5.1525
Zakht	2.7	0.090	30.3	1.010	11.2222
Gandam-2002	4.6	0.153	29.2	0.973	6.3478
Saleem-2000	2.6	0.086	28.3	0.943	10.8846
Bhakkar-01	6.5	0.216	25.0	0.833	3.8461
Tatara	2.8	0.093	24.6	0.820	8.7857
Fakhr-E-Sarhad	4.4	0.146	20.0	0.666	4.5454
Bakhtawar-92	3.5	0.116	19.4	0.646	2.6216

* Minerals per single grain was obtained as mean

Table 2: Micronutrient contents of wheat varieties growing in the same ecological conditions of district Chitral

	Sodium (ppm)		Potassium (ppm)		
Name	30 grains	Single grain*	30 grains	Single grain*	K^+/Na^+ ratio
Tuf	1.7	0.056	31.2	1.04	18.3529
Oqab	2.4	0.08	36.6	1.220	15.2500
Zakht	2.7	0.09	30.3	1.01	11.2222
Watan	3.99	0.13	43.5	1.45	11.1538
Fakhr e Sarhad	2.8	0.09	27.7	0.923	9.8982
Inqilab-91	4.8	0.16	44.5	1.483	9.2708

Table 3: Moisture contents of different wheat varieties growing at different ecological regions of Pakistan

	Wt. per 100 grains (g)				
Wheat variety	Initial Wt.	Final Wt.	Difference	Moisture per Single grain (g)	Moisture per 1000 grains (g)
Wafaq-01	4.3602	4.0055	0.3547	0.003547	3.547
Oqab	4.4075	4.0530	0.3545	0.003545	3.545
Tatara	4.1484	3.8023	0.3461	0.003461	3.461
Chudry-97	4.0210	3.6880	0.3330	0.003330	3.330
Gandam-2002	3.9297	3.6417	0.2880	0.002880	2.880
Gandam-711	3.9531	3.6688	0.2843	0.002843	2.843
Saleem-2000	3.6071	3.3249	0.2822	0.002822	2.822
Fakhr-E-Sarhad	3.6860	3.4075	0.2785	0.002785	2.785
Bhakkar-01	3.4025	3.1367	0.2658	0.002658	2.658
Tuf	4.0053	3.7470	0.2583	0.002583	2.583
Inqilab -91	3.3495	3.0915	0.2580	0.002580	2.580
Bakhtawar-92	3.1108	2.8580	0.2528	0.002528	2.528
Ghaznawy	3.5133	3.2408	0.2725	0.002725	2.527
Watan	3.5724	3.3308	0.2416	0.002416	2.416
Zakht	3.5074	3.3204	0.187	0.001870	1.870

Table 4: Moisture contents of wheat varieties growing in the same ecological conditions of district Chitral

	Wt. per 100 grains (g)				
Name	Initial Wt.	Final Wt.	Difference	Moisture per Single grain (g)	Moisture per 1000 grains (g)
Oqab	4.4075	4.0530	0.3545	0.003545	3.545
Fakhr-E-Sarhad	4.7030	4.3506	0.3524	0.003524	3.524
Watan	4.2226	3.9296	0.293	0.00293	2.930
Inqilab-91	3.8084	3.5433	0.2651	0.002551	2.651
Tuf	4.0053	3.7470	0.2583	0.002583	2.583
Zakht	3.5074	3.3204	0.187	0.00187	1.870

Table 5: Electrical conductivity of different wheat varieties growing at different ecological regions of Pakistan

	Electrical conductivity (μS)					
	Imbibitions period (min)					
Wheat variety	10	20	30	40	50	60
Oqab	96.0	103.8	120.5	125.2	126.4	129.2
Tuf	104.2	110.8	115.3	119.9	122.5	125.7
Zakht	100.3	112.5	115.1	117.1	120.5	123.4
Watan	68.1	80.0	86.1	89.4	91.2	97.0
Gandam-711	66.6	74.6	84.9	88.8	92.0	95.0
Chudry-97	58.8	66.8	68.8	72.0	72.6	73.5
Inqilab -91	41.7	54.4	58.0	62.0	64.0	64.7
Wafaq-01	37.5	43.0	46.7	51.3	52.3	54.4
Gandam-2002	37.4	42.8	44.6	48.8	50.0	51.7
Bhakkar-01	35.2	38.9	43.5	48.0	50.2	51.2
Ghaznawy	30.1	37.1	38.7	42.0	43.8	45.3
Saleem-2000	28.8	35.1	37.3	40.1	40.9	43.3
Fakhr-E-Sarhad	28.1	36.8	37.8	41.1	42.0	42.8
Tatara	24.6	30.0	32.5	37.5	39.3	39.8
Bakhtawar-92	21.0	24.6	26.9	30.0	32.0	33.0

of 127-149.5 and 96.0-129.2 μS, respectively. Inqilab-91 and Fakhr-e-Sarhad shows the lowest level out of these varieties with 91-106.2 and 79.0- 97.3 μS, respectively.

Thousand Grain Mass (TGM): Thousand Grain Masses of each different varieties growing in different ecological region of Pakistan is presented in Fig. 1. Data represents

Table 6: Electrical conductivity of wheat varieties growing in the same ecological conditions of district Chitral

	Electrical conductivity					
	Imbibitions period (min)					
Wheat variety	10	20	30	40	50	60
Watan	127.0	134.5	142.3	145.6	147.6	149.5
Oqab	96.0	103.8	120.5	125.2	126.4	129.2
Tuf	104.2	110.8	115.3	119.9	122.5	125.7
Zakht	100.3	112.5	115.1	117.1	120.5	123.4
Inqilab-91	91.0	93.5	98.2	101.4	103.2	106.2
Fakhr e Sarhad	79.0	81.1	87.6	92.4	95.7	97.3

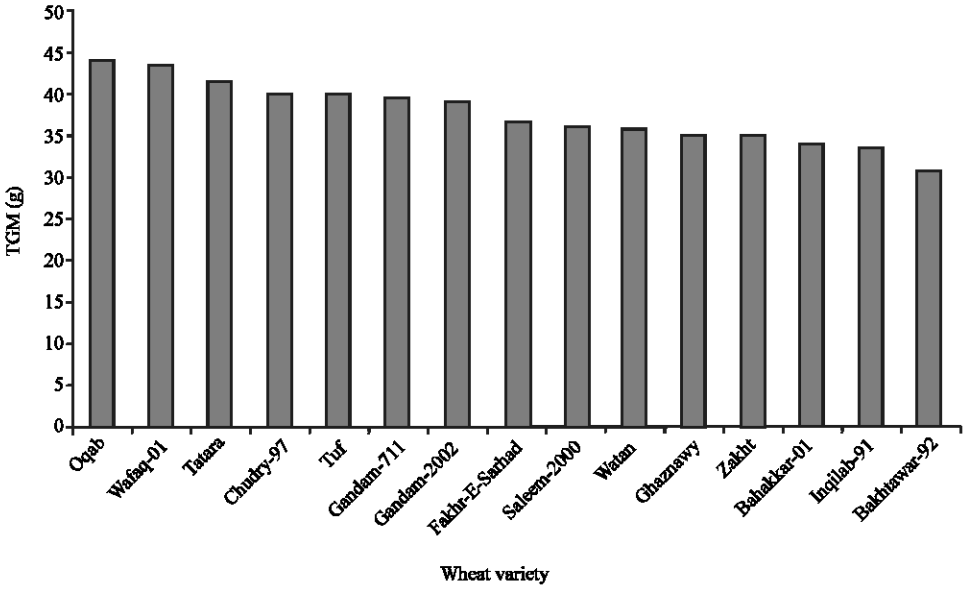

Fig. 1: Thousand Grain Mass (TGM) of different wheat varieties growing at different ecological regions of Pakistan

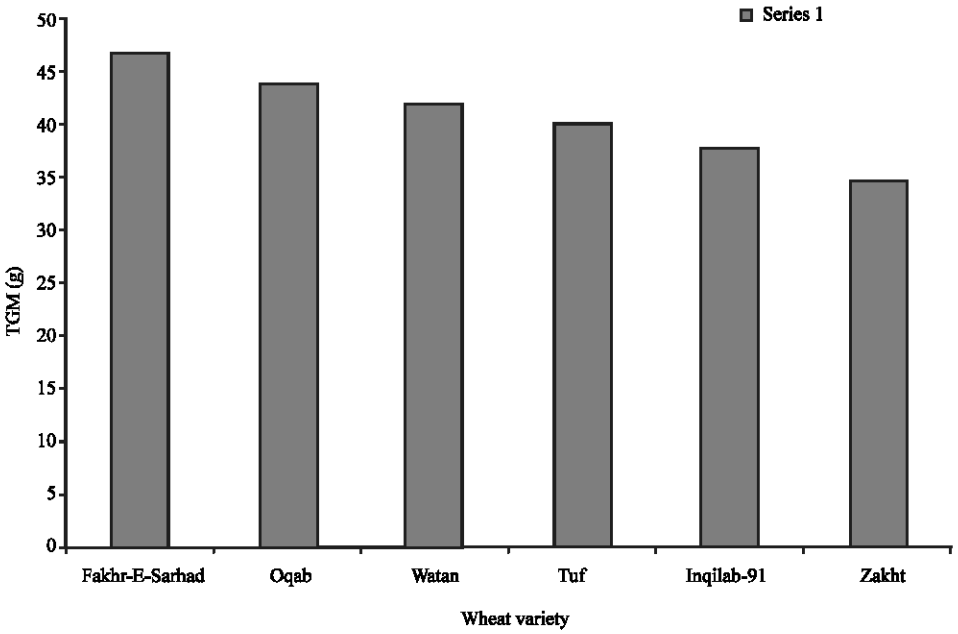

Fig. 2: Thousand Grain Mass (TGM) of different wheat varieties growing at same ecological region of Chitral Pakistan

the high mass of Oqab, Wafaq-01 and Tatara with 44.075, 43.602 and 41.484, respectively. Bhakkar-01, Inqilab-91 and Bakhtawar-92 have less TGM with a value of 34.025, 33.495 and 31.108, respectively. For Chitral varieties Fakh-e- sarhad from district Chitral shows a high TGM with a value of 47.030 g, the least TGM was found in Zakht Variety with 35.074 g as show in Fig. 2.

DISCUSSION

The *mineral nutrients* of different wheat varieties growing at different ecological condition are very important for the determination of productivity and suitability as food. An average potassium content of Watan variety is 1.466 ppm per single grain; Gandam-711 is placed on second position containing 1.390 ppm. The lowest level of potassium is present in Bakhtawar- 92 with 0.646 ppm. Sodium content of Chudry- 97 is 7.4 ppm, Bhakkar-01 with 6.5; Inqilab-91 on third position with 6.3 ppm. This study shows little inverse situation than Iqbal *et al.* (2001), which present a high level of K^+ in Bakhtawar variety as compared to others. The reason is that he used other varieties for comparison which contain less level of potassium. Ashraf *et al.* (2001) show that Na^+ concentration remains constant throughout the Imbibition period while our study shows an increase level after each interval. This is due to the fact that more shaking is responsible for high rate of this mineral. Micronutrient composition of wheat varieties growing in the same ecological condition of district Chitral is shown in Table 2. Tuf and Oqab shows a high level of Potassium and K^+/Na^+ ratio with the value of 18.3529 and 15.25, respectively. Fakhr-e-Sarhad shows the lowest level of K^+/Na^+ and highest level of sodium. Fakhr-e-Sarhad variety growing in district Chitral shows high K^+/Na^+ ratio than grown in other part of the country with a difference of 5.3528. Similar trend is observed in Watan and Inqilab varieties. This means Chitral varieties are good in term of K^+/Na^+ ratio.

*Moisture content*s were measured in order to know the amount of water present in each variety of wheat, which is very important in term of productivity (Khan and Kulachi, 2002). Data regarding moisture contents of different wheat varieties growing at different ecological region of Pakistan shows that wheat variety Wafaq-01 contains highest of moisture with 3.547 g per 1000 grains; Oqab has 3.545 g. The lowest moisture content is present in Zakht with 1.870 g per 100 grains. Moisture contents of wheat variety of district Chitral are presents, Oqab and Fakhr-e-Sarhad varieties have 3.45 and 3.524 g per 1000 grains, respectively. The lowest level is present in Tuf and Zakht with 2.583 and 1.87 g. By comparing the same and different ecological conditions it is clear that Fakhr-e-Sarhad variety growing in District Chitral shows high moisture contents than varieties grown in other part of the country with a difference of 0.739 g per 1000 grains. Similar trend is observed in Watan and Inqilab varieties. But this increase is not well significant; however varieties growing in Chitral are superior in term of moisture content.

Electrical Conductivity (EC) is a good tool to measure the amount of ions of minerals comes out of the seed during Imbibition. Data regarding EC after each 10 min of Imbibition shows that EC value increases after each interval of 10 minutes. Oqab, Tuf and Zakht variety were place on the top having 96-129.2, 104.2-125.7 and 100.3-123.4 μS, respectively. Fakhr-e-Sarhad, Tatara and Bakhtawar-92 shows less level of 28.1-42.8, 24.6-39.8 and 21.0-33 μS. Ashraf and Hussain, (1998) show a similar increasing trend in electrical conductivity. Data of different wheat varieties growing in the same ecological region of district Chitral shows that Watan and Oqab contains high level of conductivity after each 10 min interval, with a value of 127-149.5 μS and 96.0 - 129.2 μS, respectively. Inqilab-91 and Fakhr-e-sarhad shows the lowest level out of these varieties with 91-106.2 and 79.0- 97.3 μS, respectively. Watan variety growing in district Chitral shows high electrical conductivity than grown in other part of the Pakistan with a significant difference of 52.2. Similar trend is observed in Fakhr-e-Sarhad and Inqilab varieties. This represents that Chitral varieties are first-class in term of electrical conductivity.

Thousand Grain Masses of each different varieties growing in different ecological regions of Pakistan represent the high thousand grain mass of Oqab, Wafaq-01 and Tatara with 44.075, 43.602 and 41.484, respectively. Bhakkar-01, Inqilab-91 and Bakhtawar-92 have less TGM with a value of 34.025, 33.495 and 31.108, respectively. Fakh-e-Sarhad from district Chitral shows a high TGM with a value of 47.030 g, the least TGM was found in Zakht Variety with 35.074 g. Akhtar *et al.* (2001) shows the average TGM for Inqilab-91 and Bakhtawar-92 as 38.67 and 39.58 g which is similar with Chitral variety and less in the rest of the varieties for Inqilab-91 and for Bakhtawar-92 our value is less by 8.472 g. TGM for Chitral varieties show higher rate than other, representing better crops.

Data shows that wheat varieties growing in the different ecological regions of Pakistan are less productive than wheat growing in the same dry temperate region of Chitral. However these results need further elaboration in order to confirm the productivity with respect to protein, starch and other components (under study).

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