PHYSIOCHEMICAL AND NUTRITIONAL EVALUATION OF SELECTED PAKISTANI WHEAT VARIETIES

Muhsin Jamal[1], Inam -ur- Rahman[1], Muhammad Asif Nawaz[1], Tahir Hussain[2], Sami Ullah[1], Muhammad Ali[2] and Muhammad Shuaib[1]

[1]Department of Biotechnology, University of Malakand, Chakdara, Dir (L), Pakistan
[2]Institute of Biotechnology and Genetic Engineering (IBGE), NWFP Agricultural University, Peshawar, Pakistan
E-Mail: muhsinkhan08@gmail.com

ABSTRACT

Malnutrition is a serious global problem today. One of the major causes of this malnutrition is that the food supplements do not provide ample nutrients for the high risk groups. In this study sixteen wheat varieties namely; Nacozari-76, Ouqab, Tatar-96, Bakhtawar-92, Yecura-70, Raj, Bakkar, Sulilman-96, Pirsabak-05, Maria, Khyber-87, Fakhr-e-Sarhad, Pirsabak-04, Inqulab-91 and Rawal-87 were evaluated for physiochemical and nutritional properties such as moisture content, ash content, electrical conductivity, thousand grain mass (TGM) and mineral composition. These properties mainly influence the quality of bread made from wheat which is the staple food of people in Pakistan. The wheat variety Ghaznavi-98 contains highest content of moisture with value of 8.38%. The lowest moisture content was present in Ouqab with 6.68%. The aim of the study was to evaluate different wheat varieties for these parameters and to find out the variety with best physiochemical and nutritional values. Data represented the high TGM (Thousand Grain Mass) of Raj with 42.80g while Fakhr-e-Sarhad has less TGM value of 28.03g per 100 grain. Electrical conductivity value (measured in micro Siemen) increased after each interval of 10 minute. Maria, Ouqab and Bakkar varieties were place on the top having electrical conductivity of 106.4-135.6uS, 95.6-132.5uS and 91.6-128.5uS, respectively. The mineral composition evaluated show that the potassium content ranges from 18.79 to 42.82 ppm per 30 grain where as the average sodium content varies from 2.6 to 6.5ppm per 30 grain. It was concluded that Raj, Inqulab-91 and Yecura-70 have good nutritional and physiochemical properties and can be manipulated further for improvement.

Keywords: wheat, thousand grain mass, electrical conductivity, micro siemens.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the leading food grain and staple diet of people of Pakistan. Wheat foods are major source of nutrients in many regions. Although seen mainly as a source of carbohydrates; these foods are also a substantive source of protein, β group vitamins, and minerals, when consumed as a major component of diet. Wheat germ and wheat bran consist of important dietary fibers which can be used in the treatment of digestive disorders (Fincher and Stone, 1986; Hoseney *et al*., 1988). Wheat is considered as one of the most primitive domesticated crop. Bread wheat plays a major role among the few crop species being widely grown as food sources, and was likely a central point to the beginning of agriculture. Now the global wheat production is concentrated mainly in Australia, Canada, China, European Union, India, Pakistan, Russia, Turkey, Ukraine and United States accounting for over 80% of world wheat production. Pakistan is the 8th largest wheat producer, sharing for 3.17% of the world wheat production from 3.72% of the wheat growing area. Wheat in Pakistan is a leading food grain and occupies a central position in agriculture and its economy (Khan *et al.,* 2007). Nowadays there is an increased interest in the production of cereal based foods, especially various types of flat breads. Flat breads are probably the oldest, most diverse and popular products in the world. The principal grains used in such breads are corn, barley and wheat. In Pakistan, 80% of the total wheat produced is used for making flat bread like chapattis, rotis, and naan. These are primary and the cheapest source of protein and calories (Anjum and Walker, 1991). Currently the research is mainly focused on the improving the grain quality by genetic engineering and plant breeding techniques. The improved varieties are rich in nutrients and have better quality and high quantity of the essential proteins, thus providing many calories in the diet (Yu-yin *et al*., 1999). Wheat is used in bread making in Pakistan which are called "Naan" (Flate bread). The essential ingredients of Naan are wheat, salt and yeast. It is the staple food of Pakistan. The flour quality required for flat bread making is still not known and research is needed in this area. However the nutritional contents of the wheat can influence the quality of flat bread (Ghulam *et al.,* 2007). As wheat and wheat based flat breads are the most common food of Pakistani population and the main source of nutrition, much research is needed to improve the grain quality in the form of protein and nutrients quantity and quality.

This research was conducted to evaluate the nutritional quality of different wheat varieties commonly used in Pakistan and also their moisture and ash content.

MATERIALS AND METHODS

Plant samples

The wheat grains of sixteen Pakistani varieties were collected from Cereal Crop Research Institute (CCRI) Nowshehra, Pakistan. The grains were stored in labeled glass bottle with insecticide tablets to ensure

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safety. The analysis was carried out at the Department of Biotechnology University of Malakand.

Physiochemical analysis

Different physiochemical characteristics like (moisture, ash, thousand grain mass (TGM), conductivity and Mineral composition (Na^+ and K^+) of different Pakistani wheat varieties were determined.

Moisture contents

Moisture contents were determined according to the method used by Khan et al. (2007). Moisture contents of 100 grains wheat sample were determined with the help of Oven. For this purpose initial weight of sample was taken and then placed in oven at 72^0C for 48 hours and second weight was taken.

Calculation

The moisture content was determined according to the formula:

Moisture contents $= $ (Initial Wt $-$ Final wt) $\times 100$ /Initial Wt

Determination of ash content

a) Principle

In ashing organic constituents of food was disintegrated to produce oxides of in- organic elements (minerals) at high temperatures in a muffle furnace at 550 ^oC. Ash content was determined using the procedure of Chapman and Pratt (1961) with slight modification.

b) Procedure

The require number of china dishes were placed in muffle furnace for 15 minutes then removed cooled in desiccators for at least one hour, when cool to room temperature each dish was weighed to the nearest mg. Accurately weighed 3g of grinded wheat grains into each china dish and was heated on hot plate under fume-hood until smoking ceases and samples become thoroughly charred. Dishes were placed in muffle-Furnace and ashed in two shocks first at 550^0C for 30 minutes and then at 850 ^0C for 30 minutes. The dishes were removed and when cool to room temperature each dish was reweighed containing white appearing ash. By difference the weight of ash was calculated.

c) Calculations

Present ash was determined as:

Ash value (%) $= $ W1/W2 $\times 100$

Where

Weight (g) of sample $= $ W1 and Weight (g) of ash $= $ W2

Thousand grain mass (TGM)

Thousand Grain Mass (TGM) is very important parameter to study the net productivity of wheat. Hundred grains were counted and their average mass was measured with help of Shimadzu electronic balance. The method is reported in work of Zeb et al. (2006).

Conductivity determination

Thirty wheat seeds of each variety were placed in 50 ml double distilled water in Petri dishes at 18^oC with occasional shaking for 1h. The electrical conductivity after each 10 minutes with a pre-calibrated conductometer was measured (Zeb et al., 2006).

Micronutrient composition

Mineral composition (Na^+ and K^+) of different wheat varieties was determined according to the method used by Zeb et al. (2006). Thirty grain was collected in a flask and add 30 ml of double distilled water. The flasks were occasionally shacked for one hour. Mineral composition (Na^+ and K^+) of wheat varieties was determined with the help of Flame photometer (Model Jenway PFP 7). The instrument was standardized by slandered potassium and sodium solution, respectively.

Statistical analysis

The data obtained was statistically analyzed using Ward's method for the finding the linkage distance.

RESULTS

Moisture contents

Moisture contents were measured to determine the level of available water in the wheat grains, which is essential for productivity. Data regarding moisture contents of different wheat varieties is given in Table-1. The wheat variety Ghaznavi-98 contains highest of moisture with value 8.38%; Inqulab-91 has 8.23% while Fakhr-e-Sarhad contains 8.03%. The lowest moisture content is presented in Ouqab with 6.68%. The moisture contents analyzed per single and per 100 grain show that the wheat variety Raj contains highest of moisture with 0.319g per 100 grain; Pirsabak-05 has 0.308g. The lowest moisture content is present in Fakhr-e-Sarhad with 0.225g per 100 grain.

Ash contents

Ashing is performed to destroy organic matter at high temperature in muffle-furnace. The ash so produced contains oxides of inorganic elements useful for metals analysis. The data regarding ash content of different wheat varieties is presented in Table-2. Ash content of Pirsabak-05 variety is 2.33% with first position; Tatar-96 has 1.93% with second position while Fakhr-e-Sarhad is at the third position containing 1.90% ash. The lowest ash content is present in Raj with value of 1.46%. Overall result indicates that ash content of wheat varieties is in range from 1.46 to 2.33%.

Thousand grain mass (TGM)

Thousand grain mass is important parameter for determination of productivity of wheat in a particular region. Thousand Grain Masses of each variety growing in different ecological region of Pakistan is given in Table-3. Data represents the high mass of Raj and Pirsabak-05 with 42.80g and 42.13g, respectively. Bakhtawar-92, Yecura-70 and Fakhr-e-Sarhad have less TGM with a value of 30.22g, 30.00g and 28.03g, respectively.

Electrical conductivity

Electrical conductivity represents the number of ion of minerals comes out of the seed during imbibition is given in Table-4. Data shows that EC value increases after each interval of 10 minute. Maria, Ouqab and Bakkar varieties were place on the top having 106.4-135.6uS, 95.6-132.5uS and 91.6-128.5uS, respectively., Pirsabak-04, Fakhr-e-sarhad and Bakhtawar-92, show less level of 25.5-54.6uS, 3.5-6.3uS, 30.4-47.35.8μS, 26.7 and -36.7μS, respectively.

Micronutrient composition

The data obtained related to mineral composition of different Pakistani wheat varieties are presented at Table-5. An average potassium content of Ouqab is 1.736 ppm per single grain and is placed in first position. Inqulab-91 is placed at second position containing 1.427ppm and Ghaznavi-98 is paced at position third with 1.045 ppm per single grain. The lowest level of potassium content is presenrt in Pirsabak-04 with 0.626 ppm per single grain. Where as average sodium content of Maria is 6.5, Pirsabak-04 with 6.4 and Ghaznavi-98 with 6.3ppm are placed in first, second and third position, respectively. The lowest sodium content of 2.6ppm is shown by Ouqab.

Statistical analysis

The data obtained from the experiments was statistically analyzed using Ward's method. The linkage distance of all the varieties was also measured. The results are shown in Figure-1. From the statistical analysis, it was shown that the data is highly significantly correlated.

Table-1. Moisture contents of different Pakistani wheat varieties.

S. No.	Wheat variety	Wt. per 100 grains (g)			Moisture per single grain (g)	Moisture per 100 grain (g)	% Moisture
		Initial Wt. (g)	Final Wt. (g)	Difference (g)			
1	Nacozari-76	3.257	3.000	0.257	0.00257	0.257	7.89
2	Ouqab	3.804	3.550	0.254	0.00254	0.254	6.68
3	Tatar-96	3.571	3.291	0.280	0.00280	0.280	7.84
4	Bakhtawar-92	3.022	2.780	0.242	0.00242	0.242	8.00
5	Yecura-70	3.00	2.772	0.228	0.00228	0.228	7.60
6	Raj	4.280	3.961	0.319	0.00319	0.319	7.45
7	Bakkar	4.058	3.785	0.273	0.00273	0.273	6.72
8	Sulilman-96	3.711	3.424	0.287	0.00287	0.287	7.73
9	Pirsabak-05	4.213	3.905	0.308	0.00308	0.308	7.31
10	Maria	3.667	3.375	0.292	0.00292	0.292	7.96
11	Khyber-87	3.319	3.065	0.254	0.00254	0.254	7.65
12	Fakhr-e-Sarhad	2.803	2.578	0.225	0.00225	0.225	8.03
13	Pirsabak-04	3.941	3.636	0.305	0.00305	0.305	7.74
14	Inqulab-91	3.572	3.278	0.294	0.00294	0.294	8.23
15	Rawal-87	3.498	3.220	0.278	0.00278	0.278	7.94
16	Ghaznavi-98	3.377	3.094	0.283	0.00283	0.283	8.38

Table-2. Ash Content of different Pakistani wheat varieties.

S. No.	Wheat variety	Ash per 3 grams	% Ash content
1	Nacozari-76	0.049	1.63
2	Ouqab	0.048	1.60
3	Tatar-96	0.058	1.93
4	Bakhtawar-92	0.045	1.50
5	Yecura-70	0.056	1.86
6	Raj	0.044	1.46
7	Bakkar	0.046	1.53
8	Sulilman-96	0.054	1.80
9	Pirsabak-05	0.070	2.33
10	Maria	0.055	1.83
11	Khyber-87	0.048	1.60
12	Fakhr-e-Sarhad	0.057	1.90
13	Pirsabak-04	0.049	1.63
14	Inqulab-91	0.050	1.67
15	Rawal-87	0.055	1.83
16	Ghaznavi-98	0.050	1.67

Table-3. Thousand-grain mass (TGM) of different Pakistani wheat varieties.

S. No.	Wheat variety	100 Grain Mass (g)	1000 Grain Mass (g)
1	Nacozari-76	3.257	32.57
2	Ouqab	3.804	38.04
3	Tatar-96	3.571	35.71
4	Bakhtawar-92	3.022	30.22
5	Yecura-70	3.00	30.0
6	Raj	4.280	42.80
7	Bakkar	4.058	40.58
8	Sulilman-96	3.711	37.11
9	Pirsabak-05	4.213	42.13
10	Maria	3.667	36.67
11	Khyber-87	3.319	33.19
12	Fakhr-e-Sarhad	2.803	28.03
13	Pirsabak-04	3.941	39.41
14	Inqulab-91	3.572	35.72
15	Rawal-87	3.498	34.98
16	Ghaznavi-98	3.377	33.77

Table-4. Electrical conductivity (µS) of different Pakistani wheat varieties per 10 seed at different interval of time.

S. No.	Wheat variety	Electrical conductivity of wheat varieties in micro- siemens (µS)					
		10 min	20 min	30 min	40 min	50 min	60 min
1	Nacozari-76	33.5	41.7	54.6	61.4	65.3	73.8
2	Ouqab	95.6	104.7	115.6	123.7	128.3	132.5
3	Tatar-96	34.5	45.7	55.6	60.4	64.3	71.8
4	Bakhtawar-92	23.6	26.7	30.4	32.4	34.5	36.4
5	Yecura-70	33.5	37.4	46.5	52.2	58.7	67.7
6	Raj	85.6	90.6	96.6	110.7	116.7	120.4
7	Bakkar	91.6	102.5	108.6	115.5	121.3	128.5
8	Sulilman-96	40.5	47.7	56.6	63.3	69.7	78.3
9	Pirsabak-05	29.5	37.6	45.3	50.6	57.4	65.7
10	Maria	106.4	110.3	116.5	124.6	129.5	135.6
11	Khyber-87	32.5	36.5	43.7	47.3	54.7	64.7
12	Fakhr-e-Sarhad	30.4	37.6	39.3	43.6	45.5	47.3
13	Pirsabak-04	33.5	35.7	41.3	47.6	55.7	60.6
14	Inqulab-91	43.5	49.7	57.4	59.6	61.6	65.8
15	Rawal-87	37.5	45.4	49.7	55.3	59.5	66.7
16	Ghaznavi-98	37.5	42.4	46.7	50.3	58.5	70.7

Table-5. Mineral nutrient contents (Na^+ and K^+) of different Pakistani wheat varieties.

S. No.	Wheat variety	Na^+ (ppm) 30 grain	Single grain Na^+ (ppm)	30 grain K^+ (ppm)	Single grain K^+ (ppm)	K^+ / Na^+ ratio
1	Nacozari-76	4.3	0.143	29.22	0.974	6.811
2	Ouqab	2.6	0.086	35.21	1.736	20.186
3	Tatar-96	3.5	0.117	26.64	0.888	7.589
4	Bakhtawar-92	3.8	0.126	23.17	0.772	6.126
5	Yecura-70	3.0	0.100	25.4	0.846	8.640
6	Raj	4.2	0.140	21.69	0.723	5.164
7	Bakkar	4.7	0.157	20.87	0.695	4.426
8	Sulilman-96	3.4	0.133	22.48	0.749	5.631
9	Pirsabak-05	4.2	0.140	23.65	0.788	5.628
10	Maria	6.5	0.216	19.76	0.658	3.046
11	Khyber-87	3.3	0.110	25.45	0.848	7.709
12	Fakhr-e-Sarhad	4.3	0.143	21.65	0.721	5.041
13	Pirsabak-04	6.4	0.213	18.79	0.626	2.938
14	Inqulab-91	5.0	0.167	42.82	1.427	8.544
15	Rawal-87	4.6	0.153	28.24	0.941	6.150
16	Ghaznavi-98	6.3	0.210	31.35	1.045	4.976

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Table-6. Correlation coefficient among 16 Pakistani wheat varieties.

	Initial Wt. (g)	Final Wt. (g)	Difference (g)	Moisture per single grain (g)	Moisture per 100 grain (g)	% Moisture	Ash per 3 grams.	% Ash content.	100 grain mass (g)	1000 grain mass (g)	10 min	20 min	30 min	40 min	50 min	60 min	Na+ (ppm) 30 grain	Na+ (ppm)	K+ (ppm)	K+ (ppm)
(g)	1.00	1**																		
e (g)	0.84	0.82*	1**																	
r single g)	0.84	0.82	1	1**																
100 grain	0.84	0.82	1	1	1**															
ture	-0.54	-0.5	-0.01	-0.01	-0.01	1**														
grams.	0.03	0.03	0.09	0.09	0.09	0.08*	1**													
ntent.	0.03	0.02	0.09	0.09	0.09	0.08	1.00	1**												
Mass (g)	1.00	1.00	0.84	0.84	0.84	-0.54	0.03*	0.03*	1**											
Mass (g)	1.00	1.00	0.84	0.84	0.84	-0.54	0.03	0.03*	1	1**										
n	0.52	0.53	0.27	0.27	0.27	-0.54	-0.31	-0.31	0.52*	0.52*	1**									
n	0.53	0.54	0.26	0.26	0.26	-0.57	-0.28	-0.28	0.53*	0.53*	1.00	1**								
n	0.54	0.55	0.26	0.26	0.26	-0.59	-0.27	-0.27	0.54*	0.54*	0.99*	1.00	1**							
n	0.56	0.57	0.28	0.28	0.28	-0.60	-0.27	-0.27	0.56*	0.56*	0.99*	0.99*	1	1**						
n	0.58	0.60	0.31	0.31	0.31	-0.61	-0.26	-0.27	0.58*	0.58*	0.98*	0.99*	0.99*	1	1**					
n	0.59	0.60	0.32	0.32	0.32	-0.61	-0.24	-0.25	0.59*	0.59*	0.97*	0.98*	0.99*	0.99*	1.00	1**				
30 grain	0.18	0.16	0.49	0.49	0.49	0.45	-0.05	-0.04	0.18	0.18*	0.14	0.10	0.05	0.05	0.06*	0.07*	1**			
om)	0.20	0.17	0.52	0.52	0.52	0.46	-0.04	-0.03	0.20	0.20	0.13	0.09	0.05	0.04	0.06*	0.07*	0.99*	1**		
om)	-0.13	-0.14	-0.06	-0.06	-0.06	0.16	-0.10	-0.10	-0.13	-0.13	-0.07	-0.05	-0.01	-0.04	-0.06	-0.06	-0.16	-0.18	1**	
om)	-0.03	-0.02	-0.13	-0.13	-0.13	-0.16	-0.16	-0.15	-0.03	-0.03	0.16	0.19	0.22	0.20	0.18*	0.17*	-0.30	-0.33	0.90*	1**
Ratio	-0.04	-0.02	-0.33	-0.33	-0.33	-0.46	-0.12	-0.12	-0.04	-0.04	0.21	0.24	0.29	0.27	0.26	0.25	-0.64	-0.66	0.61	0.87

*Significant
** Highly significant

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DISCUSSIONS

Physiochemical mainly influence the quality of bread made from wheat. Moisture contents were measured to determine the level of water in wheat grains, which is an important factor in terms of productivity Khan *et al.* (2007). Data regarding moisture contents of different wheat varieties is given in Table-1. The wheat variety Ghaznavi-98 contains highest moisture content with value of 8.38 %; Inqulab-91 has 8.23% while Fakhr-e-Sarhad contains 8.03%. The lowest moisture content is presented in Ouqab with 6.68%. The moisture contents range from 6.68 to 8.38 %; that show a relationship with the result of Ahmad *et al.* (1993) and Zeb *et al.* (2006). Moazzam *et al.* (2009) reported moisture contents of different wheat varieties varying from 12.92 to 13.42%. The variety Ghaznavi and Fakhr-e-sarhad have reported to contain moistures 7.32% and 9.32% respectively, Qazi *et al.* (2003), the difference might be due to stored and fresh samples used for analysis. The moisture contents analyzed per single and per 100 grains show that the wheat variety Raj contains the highest level of moisture with 0.319g per 100 grains. Pirsabak-05 has 0.308g. The present results show similarity with the result of Khan *et al.* (2007) who reported moisture content per 100 grains of Bakhtawar-92, Fakhr-e-Sarhad and Inqilab-91. The lowest moisture content is present in Fakhr-e-Sarhad with 0.225g per 100 grains.

Ash is whitish color residue remaining after destruction of organic matter at high temperature in muffle-furnace. The ash so produced contains oxides of inorganic elements useful for metals analysis. The data regarding ash content of different wheat varieties is presented in Table-2. The result is supported by Shahedur and Abdul (2011) and Ijaz *et al.* (2001). They reported ash contents of wheat in range of 1.17-2.96% and 1.32-1.85%, respectively. Overall result indicates that ash content of wheat varieties range from 1.46 to 2.33%. Ahmad *et al*., 1993 reported ash content in range of 1.06 to 2.78 %. The present result is 0.35 % lower than 1.81 and 0.51 % lower than 2.84. This reflects the variation in wheat varieties used in the study and amount of inorganic matter in the grains that showed high ash content.

Grain weight is an indication of grain size, grain yield as well as flour yield. Thousand grain mass is important parameter for determination of productivity of wheat in a particular region. Thousand Grain Masses of each variety growing in different ecological region of Pakistan is presented in Table-3. Data represents the high mass of Raj and Pirsabak-05 with 42.80g and 42.13g respectively. Bakhtawar-92, Yecura-70 and Fakhr-e-Sarhad have less TGM with a value of 30.22g, 30.00g and 28.03g respectively. Khan *et al.* (2007) and Ikhtiar and Zeb (2007) have reported thousand grain masses (TGM) of different wheat varieties in the range of 31.108~43.602 g and 28 -52.3g respectively correlated with present results. Khan *et al*. 2007 reported a TGM value of 31.1g for Bakhtawar-92, which is 0.88g

higher than our value of. 30.22g. the reason for this high value might the fresh grains has used.

Electrical Conductivity (EC) is a good tool to measure the amount of ions of minerals comes out of the seed during imbibitions. Maria, Ouqab, Bakkar variety were placed on the top having 7.6-12.8, 5.5-11.0 and 4.3-10.8uS, respectively. Fakhr-e-sarhad, Khyber-87 and Pirsabak-04 shows less level of 3.0-6.6, 3.5-6.3 and 2.8-5.8 µS. Ashraf and Hussain (1998) and Zeb *et al.* (2006) show a similar increasing trend in electrical conductivity. Data of different wheat varieties growing in the different ecological region of Pakistan show that Maria, Ouqab, Bakkar contains high level of conductivity after each 10 min interval, 106.4-135.6uS, 95.6 -132.5uS and 91.6-128.5uS, respectively. Fakhr-e-Sarhad, Khyber-87 and Pirsabak-04 show less level of 25.5 - 54.6uS, 3.5-6.3uS, 30.4-47.35.8µS, 26.7-36.7µS, respectively.

Mineral content of different wheat varieties growing at various ecological condition are very important for determination of productivity, and the nutrational value of food also depends on these minerals such as Na^+ and K, which are required for several processes in human body. Sodium content of Maria is 6.5ppm, Pirsabak-04 with 6.4ppm and Ghaznavi-98 with 6.3ppm are placed at first, second and third position, respectfully. The lowest sodium content of 2.6ppm is shown by Ouqab. An average potassium content of Ouqab is 1.736 ppm per single grain and is placed in first position. Inqulab-91 is placed at second position containing 1.427ppm and Ghaznavi-98 is paced at position third with 1.045 ppm per single grain. The lowest level of potassium content is presented in Pirsabak-04 with 0.626 ppm per single grain. Our study shows similar results with Zeb *et al.* (2006). They reported Na^+ level ranges from 2.4 to 7.4ppm per 30 grain where as K^+ level ranges from 19.4 to 44.5 ppm per 30 grains. Our result shows potassium content ranges from 18.79 to 42.82 ppm per 30 grains and sodium content ranges from 2.6 to 6.5ppm per 30 grains. Such type of relation in which there is gradual increase in level after each interval is shown. Table-5 shows micronutrient composition of different Pakistani wheat varieties. Ouqab, Yecura-70 and Inqulab-91 show a high value of K^+ / Na^+ ratio of 20.186, 8.640, 8.544 per 30 grains, respectfully. The lowest level of potassium content is presenrt in Pirsabak-04 with 0.626 ppm per single grain. Ouqab variety is the best one regarding K^+/ Na^+ ratio that of 20.186ppm.

CONCLUSIONS

It was concluded from this study, that the various physiochemical properties such as moisture content, thousand grain mass, electrical conductivity and nutritional composition (Na^+ and K^+) highly varies among different Pakistani wheat varieties. These properties are better tool for selection of best wheat varieties with respect to productivity and mineral composition.

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