

Biochemical variability among wheat cultivars grown in Khyber Pakhtunkwa

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Abstract: In order to highlight the nutritional significance of wheat flour, six wheat cultivars growing in Khyber Pakhtunkhwa were analyzed for biochemical content in Post graduate laboratory Department of Agricultural Chemistry Khyber Pakhtunkhwa Agricultural University Peshawar. The experiment was laid out in completely randomized design with three replications. Wheat cultivars varied significantly for all the traits studied indicating there is huge variability among the wheat cultivars growing in Khyber Pakhtunkhwa with respect to its biochemical composition. Moreover, Pirsabak-2008 showed maximum values for ash content (2.23%), moisture content (10.0%), gluten content recorded on wet basis (22.8%) and gluten content recorded on dry basis (11.9%), whereas, maximum fat content (5.93%), protein content (19.0%) and phytic acid content (0.850 %) were recorded for Atta Habib. In addition, maximum fibre content (2.40%) and nitrogen free extract (71.5%) were observed for wheat cultivar Pirsabak-2005 and Pirsabak-2004, respectively. On the basis of bio chemical characteristics, wheat cultivars; Siran-010, Atta Habib and Pirsabak-2004-05 would be recommended to use for chapatti production.

Keywords: Wheat, proximate analysis, gluten, phytic acid.

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INTRODUCTION

Wheat is an important human food, its production being second only to maize among the cereal crops¹. Pakistan is the 8th largest wheat producer, contributing about 3.17% of the world wheat production from 3.72% of the wheat in growing area. Wheat flour is a powder made from the grinding of wheat used for human consumption. It is used extensively in many parts of the world for the preparation of different types of bread, chapatties and many other bakery products^{2,3}.

Wheat varieties are called "clean," "white," or "brown" if they have high gluten content, and they are called "soft" or "weak" flour if gluten content is low. These are primary and the cheapest source of protein and calories for the population⁴. 100 grams of hard red winter wheat contain about 12.6 grams of protein, 1.5 grams of total fat, 71 grams of carbohydrate, 12.2 grams of dietary fiber, and 3.2mg of iron, the same weight of hard red spring wheat contains about 15.4 grams, of protein, 1.9 grams of total fat, 68 grams of carbohydrate, 12.2 grams of dietary fiber, and 3.6 mg of iron¹. Phytic acid has often been considered as an anti nutrient due to its ability to bind minerals and proteins, either directly or indirectly, and thus change their solubility, functionality, absorption, and digestibility⁵. Most of the minerals contents in wheat are tied up with phytate to form complexes and ultimately make the wheat nutritionally inferior. The whole wheat meals contain 0.30% and bran contains 5% phytate. The objective of this study was to assess biochemical variability for proximate composition, gluten content and phytic acid among wheat varieties

in order to highlight their nutritional significance.

MATERIALS AND METHODS

Biochemical characteristics of six wheat varieties (whole wheat flour) grown in Pakistan. Grains of six wheat varieties named as Siran-010, Atta Habib, Pirsabak-2008 Pirsabak-2005, Pirsabak-2004 and Saleem-2000 was collected from Malakandair Research Farm, The University of Agriculture Peshawar. The samples were cleaned, de husked manually and sub samples were made from the grains of each variety. Wheat grains of each variety will be milled to get whole-wheat flour using laboratory mill 3100 Perton and then will be analyzed for proximate composition, gluten content, phytic acid content at Department of Agricultural Chemistry, The University of Agriculture Peshawar.

Proximate composition

Proximate composition including moisture, crude protein (N* 5.7), crude fat, crude fiber and total Ash contents were determined according to AOAC (2003) Official methods, 25.09, 979.09, 923.05, 962.09 and 923.03 respectively. Total carbohydrate excluding crude fiber was calculated by difference. Moisture content, crude protein and crude lipid were determined by oven, Kjeldahl and Soxhlet apparatus, respectively.

Gluten content

The determination of gluten content were made on dry and wet basis in accordance with the convention of American Association of Cereal Chemist (AACC, 2000), method (38-10 and 38-11).

Phytic acid

Method developed by Haug and Lantzch (1983) was used for the determination of phytic acid. This method is based on the phytic precipitation with an acid iron-III solution of known iron content.

Statistical analysis

The data recorded on each parameter were subjected to analysis of variance techniques appropriate for Completely Randomized Design through M-StatC computer program for statistical analysis. The mean differences for all the parameter studied will be determined by using Least Significant Differences (LSD) test at 5% level of probability as suggested by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Proximate analysis

Fat content

The average fat content of wheat cultivars viz Pirsaback-2008, Pirsaback-2005, Pirsaback-2004, Atta Habib, Saleem-2000 and by Siran-010 represented by mean figure 1. It showed that fat content ranged from 4.00 to 5.93% with the mean value of 4.87%. Maximum fat content were recorded for wheat cultivar Atta Habib (5.93%), followed by Saleem-2000 (5.67%) and Pirsaback-2005 (5.33%), whereas, minimum fat content were observed for Pirsaback-2004 (4.00%), followed by Siran-010 (4.10%) and Pirsaback-2008 (4.17%) (Figure 1). The coefficient of difference for fat content is 7.84% (Table 1). Our results are in contrast with the observation made by Miraj *et al.*, (2008), they reported that maximum crude fat content of whole wheat flour was found lower in Khyber-87 (1.74%) and higher in Fakhr-e-sarhad (2.21%).

Fiber content

The average fiber content of wheat cultivars viz Pirsaback-2008, Pirsaback-2005, Pirsaback-2004, Atta Habib, Saleem-2000 and by Siran-010. Mean graph showed that fibre content ranged from 1.93 to 2.40 with the mean value of 2.10 %. Maximum fibre content were observed for wheat cultivar Pirsaback-2005 (2.40 %), followed by Atta Habib (2.17 %) and Pirsaback-2008 (2.13 %), whereas, minimum fibre content were observed for wheat cultivar Siran-010 (1.93 %), followed by Saleem-2000 (1.99 %) and Pirsaback-2004 (2.00 %) (Fig. 1). Wheat varieties have Significant differences ($P \leq 0.05$) for fibre content. Coefficient variation for fibre content was 7.00 % (Appendix 3).Crude fiber is recognized as a healthy food component (Khan *et al.*, 2007). Our results of crude fiber are also supported Ijaz *et al.*, (2001) who found significant variations in proximate composition in 44 spring wheat varieties. Moisture content ranged from 9.33 -10.50%, ash 1.32 - 1.85%,

crude fat 1.96 to 2.52%, crude fiber 2.31 to 2.99%, crude protein 10.13 to 14.74%, wet gluten 23.58 to 38.71% and dry gluten 7.51 to 13.52%.

Ash content

The average ash content of wheat cultivars viz Pirsaback-2008, Pirsaback-2005, Pirsaback-2004, Atta Habib, Saleem-2000 and by Siran-010. Mean graph showed that ash content ranged from 1.00 to 2.23% with the mean value of 1.49%. Maximum ash content were recorded for wheat cultivar Pirsaback-2008 (2.23%), followed by Siran-010 (1.67%) and Atta Habib (1.60%), whereas, minimum ash content were observed for Pirsaback-2005 (1.00 %), followed by Saleem-2000 (1.20 %) and Pirsaback-2004 (1.27%) (Figure 1). Wheat cultivars varied significantly ($p \leq 0.01$) for ash content. The coefficient of variation for ash content was 8.64% (Appendix 4). The results of our study are similar to that of Miraj *et al.*, (2008) who reported that maximum ash content was found for Fakhr-e-sarhad (2.12%) and minimum was found for Saleem-2000 (1.05%).

Nitrogen free extract

The average NFE content of wheat cultivars viz Pirsaback-2008, Pirsaback-2005, Pirsaback-2004, Atta Habib, Saleem-2000 and by Siran-010. Mean graph showed that nitrogen free extract ranged from 61.7 to 71.5 % with mean value of 67.6%. Maximum nitrogen free extract were recorded for wheat cultivar Pirsaback-2004 (71.5 %), followed by Siran-010 (71.4 %) and Saleem-2000 (69.5 %), whereas, minimum nitrogen free extract were observed for Atta Habib (61.7 %), followed by Pirsaback-2008 (63.2 %) and Pirsaback-2005 (68.0%) (Figure 2).

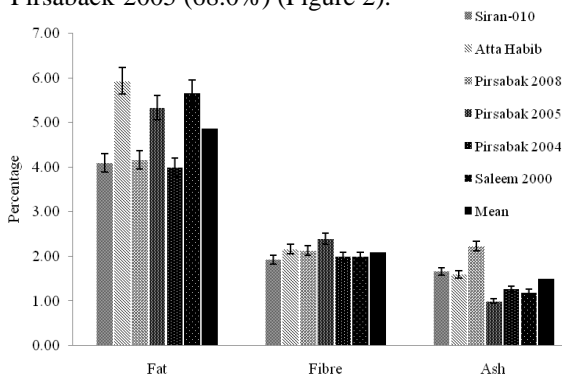


Figure 1: Mean fat, fiber and ash content of six wheat cultivars in Khyber Pukhtunkhwa.

Analysis of variance showed extremely significant differences ($p \leq 0.01$) among wheat cultivars for nitrogen free extract. The coefficient of difference for nitrogen free extract is 2.22 % (Appendix 5). Our results are similar with Kadam *et al.* (2012), they reported that the nutritious flours from various food commodities (wheat flour, chickpea, and soybean and methi leaves powder) to

make good quality of chapatties. They contained proteins (11.8 to 15.37%), fat (1.53 to 3.45%), fiber (1.24 to 2.05%), ash (2.08 to 2.70%) and carbohydrates (65.99 to 74.2%).

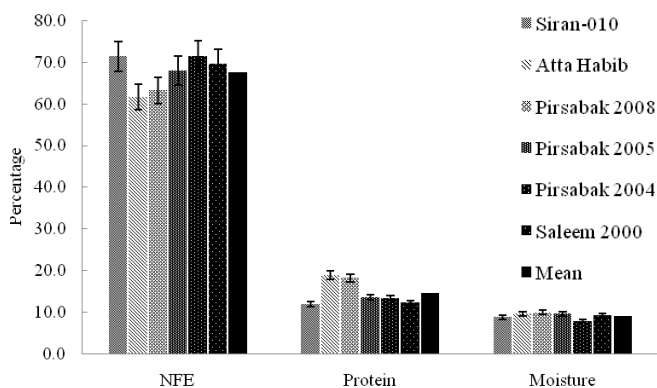


Figure 2: Mean NFE, protein and moisture content in six wheat cultivars in Khyber Pukhtunkhwa.

Protein content

The average protein content of wheat cultivars viz Pirsabak-2008, Pirsabak-2005, Pirsabak-2004, Atta Habib, Saleem-2000 and by Siran-010. Mean graph showed that protein content ranged from 12.1 to 19.0% with mean value of 14.8%. Maximum protein content were observed for wheat cultivar Atta Habib (19.0%), followed by Pirsabak-2008 (18.3%) and Pirsabak-2005 (13.6%), whereas, minimum protein content were observed for wheat cultivar Siran-010 (12.1%), followed by Saleem-2000 (12.3%) and Pirsabak-2004 (13.4%) (Figure 2). Highly significant differences ($P \leq 0.01$) among wheat cultivars were observed for protein content. The coefficient of variation for protein content was 6.47% (Appendix 6). Our results are closely match with Miraj et al., (2008) who analyzed whole wheat (*Triticum aestivum*) flour of six different cultivars for biochemical physical and sensory characteristics. The maximum level of protein content (16.11%) was found in wheat cultivar Pirsabaq-2005 whereas, minimum protein content was found in Auqab (11.73%). Wheat is considered as highest among the cereals largely due to the fact, that its grain contains protein with only one of its kind chemical plus physical properties. It is the chief and the cheapest source of protein plus calories used for the population¹⁰.

Moisture content

Average moisture content of wheat cultivars viz Pirsabak-2008, Pirsabak-2005, Pirsabak-2004, Atta Habib, Saleem-2000 and by Siran-010 represented by mean graph 2. Mean graph showed that moisture content ranged from 7.8 to 10.0% with the mean value of 9.2%. Maximum moisture content were recorded for wheat cultivar Pirsabak-2008

(10.0%), followed by Atta Habib and Pirsaback-2005 (9.7%), whereas, minimum moisture content were observed for Pirsaback-2004 (7.8%), followed by Siran-010 (8.8%) and Saleem-2000 (9.3%) (Figure 2). Wheat cultivars varied significantly ($p \leq 0.05$) for moisture content. The coefficient of variation for moisture content was 7.56% (Appendix 7). The moisture content of flour vary from 11-15% and depending upon the condition of the storage and hygroscopic nature of starch, but it should be less than 13%¹¹. The result of our present research are in the line with earlier findings of Ijaz et al., (2001), they found significant variations in proximate composition in 44 spring wheat varieties. Moisture content ranged from 9.38 to 10.43%, ash 1.32 to 1.85%, crude protein 10.13 to 14.74%, crude fat 1.96 to 2.52%, crude fiber 2.31 to 2.99%, wet gluten 23.58 to 38.71% and dry gluten 7.51 to 13.52%.

Gluten wet basis

The average gluten wet content of wheat cultivars viz Pirsabak-2008, Pirsabak-2005, Pirsabak-2004, Atta Habib, Saleem-2000 and by Siran-010 represented by mean graph 3. Mean graph showed that gluten content measured on wet basis ranged from 61.7 to 71.5% with mean value of 67.6%. Maximum gluten content recorded on wet basis were recorded for wheat cultivar Pirsabak-2008 (22.8%), followed by Siran-010 and Pirsabak-2005 (22.5%), whereas, minimum gluten content calculated on wet basis were observed for Saleem-2000 (16.5%), followed by Pirsabak-2004 (17.3%) and Atta Habib (19.6%) (Figure 3). Wheat cultivars varied significantly ($p \leq 0.01$) between wheat varieties in the favor of gluten content recorded on wet basis. The coefficient of variation for gluten content on wet basis was 4.92% (Appendix 8). Wheat is measured as highest among the cereals mainly due to the fact, that its grain contains protein with only one of its kind substance and physical properties¹². Wheat flour is used for the baking because it contains sufficient amount of gluten and gliadin protein, necessary for expansion¹³. Our results are closely in the range with Arif et al., (2006) who studied a number of physicochemical and rheological properties of five marketable wheat varieties and reported significant variation in wheat varieties i.e. wet gluten (23 to 39.7%).

Gluten dry basis

The average gluten dry content of wheat cultivars viz Pirsabak-2008, Pirsabak-2005, Pirsabak-2004, Atta Habib, Saleem-2000 and by Siran-010. Mean graph showed that gluten content measured on dry basis ranged from 8.2 to 11.9% with mean value of 10.0%. Maximum gluten content recorded on dry basis were recorded for wheat

cultivar Pirsaback-2008 (11.9%), followed by Pirsaback-2005 (11.8 %) and Siran-010 (10.4%), whereas, minimum gluten content calculated on dry basis were observed for Atta Habib (8.2 %), Pirsaback-2004 (8.4%) and Saleem-2000 (9.6%) (Figure 3). Highly significant differences ($p \leq 0.01$) among wheat cultivars were observed for gluten content recorded on dry basis. The coefficient of variation for gluten content on dry basis was 6.20% (Appendix 9). The unique bread making properties of wheat flour are mainly due to its gluten proteins to form a viscous elastic network when mixed with water¹¹. Wheat flour is used for the baking because it contains sufficient amount of gluten and gliadin protein, necessary for expansion¹³. Our results are closely come in the range with Ijaz *et al.*, (2001) who found significant variations in proximate composition in 44 spring wheat varieties. Moisture content ranged from 9.38 to 10.43%, ash 1.32 to 1.85%, crude protein 10.13 to 14.74%, crude fat 1.96 to 2.52%, crude fiber 2.31 to 2.99%, wet gluten 23.58 to 38.71% and dry gluten 7.51 to 13.52%.

Phytic acid content

The average phytic acid content of wheat cultivars viz Pirsaback-2008, Pirsaback-2005, Pirsaback-2004, Atta Habib, Saleem-2000 and by Siran-010. Mean graph showed that phytic acid content ranged from 0.325 to 0.850% with the mean value of 0.683%. Maximum phytic acid were recorded for wheat cultivar Atta Habib (0.850 %), followed by Saleem-2000 (0.823%) and Pirsaback-2004 (0.740%), whereas, minimum phytic acid content were observed for Siran-010 (0.325%), followed by Pirsaback-2008 (0.661%) and Pirsaback-2005 (0.669%) (Figure 3). Wheat cultivars varied significantly ($p \leq 0.01$) for phytic acid content. The coefficient of variation for phytic acid content was 3.28% (Appendix 10). Phytic acid is considered as anti nutritional factor due it binding, the bioavailability and metabolism of minerals elements. Phytic acid usually binds with the bivalent and trivalent metallic ions such as Fe²⁺, Fe³⁺, Cu²⁺, Zn²⁺ hence leading to the deficiency of these minerals. Our result are closely match with the earlier findings of Pozrl *et al.*, (2009), they reported that the wheat of flour type 500, 850, and whole meal flour, phytic acid contents was 0.438, 0.576, and 0.946g/100g dm, respectively. Wheat of meals has 0.30% and bran has 5% phytate.

CONCLUSION

Wheat cultivars grown in Khyber Pakhtunkhwa showed high genetic variability and potential for proximate composition, gluten and phytic acid

content, and can be used in future breeding programs. Atta Habib showed maximum value for fat and protein content, whereas, Pirsabak-2008 exhibited maximum values for gluten content (both wet and dry basis) and Siran-010 showed minimum value for phytic acid content. Therefore, wheat cultivars; Siran-010, Atta Habib and Pirsabak-2004-05 would be better to use for chapatti production.

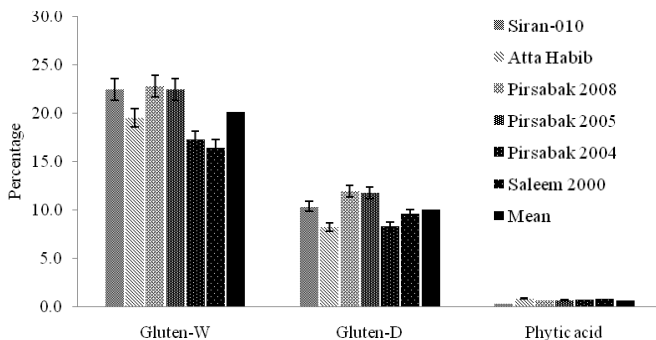


Figure 3: Mean gluten wet base, gluten dry base and phytic acid content of six wheat cultivars in Khyber Pukhtunkhwa.

Table 1: Mean squares for proximate composition, gluten and phytic acid content of six wheat cultivars evaluated at The University of Agriculture Peshawar.

Traits	Wheat cultivars (df=5)	Error (df=12)	CV (%)
Fat content	2.295**	0.146	7.84
Fiber content	0.087*	0.022	6.43
Ash content	0.582**	0.017	8.64
Nitrogen free extract	52.839**	2.24	2.22
Protein content	27.896**	0.912	6.47
Moisture content	1.856*	0.486	7.56
Gluten content (wet basis)	24.251**	0.987	4.92
Gluten content (dry basis)	7.758**	0.388	6.20
Phytic acid content	0.108	0.0005	3.28

*and** showed significant differences at 5 and 1% level of probability, whereas, CV=Coefficient of variation and df = Degree of freedom

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