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COMPARATIVE NUTRIENTS ANALYSIS OF WEED-AFFECTED AND WEEDY CHECK VARIETIES OF WHEAT

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ABSTRACT

Grains of different wheat varieties (Saleem 2003, Fakhr-e-Sarhad, Ghaznavi-98, Khattakwal, Dera-91, and Pirsabak) were analyzed for their proximate composition, starch and mineral contents i.e., P, Fe, Na and K to evaluate their nutritional significance in human diet. Weedy check variety was compared to weed affected varieties to determine the effects of weed, Avena fatua on the nutritional composition of wheat. Moisture contents were in the range of 4.95 to 8.4%, the maximum amount noted was for Dera 91. Protein content was high in Pirsabak i.e., 12.89%. The fat content was in the range of 1.00 to 1.60%, while fiber, ash and NFE were present in appreciable amount in all varieties. Among the minerals P was highest and its concentration was from 120- 167 mg.100^{-1}g. The maximum amount was found to be in Fakhr-e-Sarhad. Fe-content was in range of 106-119 mg.100^{-1}g. The maximum amount 119 mg.100^{-1}g was observed for Pirsabak. Na and K were high for weed Khattakwal 130 mg.100^{-1}g and 126 mg.100^{-1} gm respectively, and were found to be lowest for weed check variety. Starch contents were found highest in weed check variety i.e. 76.6%. No significant variation on nutrient composition was observed among different varieties of wheat and it can be concluded that weed has no significant effect on the nutritional quality of wheat grains.

Key words: Nutrients, *Triticum aestivum*, weeds, wheat.

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INTRODUCTION

Grains are the seeds of cereal plants and characterized by their small size hardness and low water contents. Most of them belong to the family Poaceae. Cereals are used as staple food from pre-historic times because of their wide cultivation, good storage qualities, blend flavor and vast consumption (Miller, 1992). The cultivation of grains for human consumption was probably developed around ten thousand BC. It signified the commencement of the era of stable civilization from the primitive unsettled nomadic life. The cereals consist of four essential parts including the endosperm, which is important and which contain nutrients comprising a considerable proportion of starch, a small amount of proteins, and a little fat. The whole grains of all cereals have almost similar chemical composition and nutritive value and provide almost all essential nutrients.

Wheat (*Triticum aestivum*) and rice (*Oryza sativa*) surpasses all the other food crops in their importance. Wheat has the highest global average, with an annual production of 560 million tons. It is estimated that nearly 73 million people would be added to the world's population every year from now until 2020 (Andersen *et al.*, 1980). The situation will cause a tremendous increase in global demand for food to fulfill that demand. Agriculturists have a challenge to tackle this situation and to provide 40% more grains in future. Wheat is a major source of dietary energy and protein for people whose daily diet is composed of cereal products. It is staple food, consumed worldwide in the form of bread, biscuits, chapatti etc. It is the predominant cereal produced and the main staple food of Pakistan. It contributes 68-75% of the total food intake in the daily diet and provides 75% of the total protein requirements (Aslam and Shams, 1992).

Wheat is cultivated on an area of more than 215 million ha around the world with production of 584 million tons (260.4 m t in developing countries and 317.7 m t in developed countries) resulting in an average of 2500 kg grain ha^{-1}. In Pakistan, it becomes for nearly 38% of the total cropped area, 30% of the value added by the major crops and 76% of the total production of food grains. The total production of wheat in Pakistan for the year 2003-04 was 19499.8 thousand tons. The major area of wheat cultivation in Pakistan lies in Punjab followed by Sindh (Agricultural Statistics of Pakistan, 2004).

Several factors influence the crop production on account of yield as well as quality of products. Firstly, yield defining factors such as radiation, secondly yield limiting factors which include soil, moisture, nutrients availability and length of growing seasons, and thirdly yield reducing factors that encompass diseases, insects and weeds. The presence of weeds within a crop can adversely affect production and quality of crops in a number of ways. Weed

competition for nutrients and other resources may the possible cause of low yield and quality of crops. Yield reduction in cereals is a great problem and weed is the important contributor in it. Several studies have proved the effect of weed population on the yield of cereal crops but very little or no study is available to link the effect of weed on quality of cereals. *Avena fatua* (wild oat) is an annual weed, it competes with wheat for light moisture and nutrients resulting low yield and quality of wheat. Yield loss depends on the density of weed population. As Wild oat density increases consequently crop loss increased. It has been demonstrated that *A. fatua* wheat competition commenced at the early stage of life cycle of wild oat. It shows longer the wild oat remain in the field the greater will be the yield reduction therefore its early eradication is utmost important to reduce crop loss.

The basic objective of the research was to prove the hypothesis that weeds population can affect nutritional quality of wheat grains. It has been mentioned by earlier workers that there is no significant effect of weed population on quality of wheat grain to confirm the findings of previous authors.

MATERIALS AND METHODS

Sample collection

A project was designed to study the effect of the weed, *Avena fatua* on the nutritional quality of wheat crop. The wheat seeds of weed affected and weedy check were obtained from Institute of Biotechnology and Genetic Engineering (IBGE), The University of Agriculture Peshawar. The grains of seven wheat varieties were taken for this project and analyzed for their proximate composition starch and mineral content (Price and Parsons, 1975). Out of theses seven, six varieties were weed affected and one was weedy check variety. All these analysis except starch were carried out at the Department of Agricultural Chemistry in the University of Agriculture, Peshawar in triplicate by using the standard method of AOAC (1990). Starch was determined by polarimetric method in Food Lab at Pakistan Council of Scientific and Industrial Research (PCSIR) during 2005.

Proximate Composition

All samples were analyzed for proximate composition i.e. moisture, crude protein, crude fat, crude fiber, ash and NFE by standard method of AOAC (1990). Moisture determination was carried out by oven drying method, for which 1 gm sample was oven dried at 105C for 6 hrs. Crude fat was determined by ether extract method using SOx let apparatus. For crude fiber analysis fat free sample was digested using 2.5% HCL solution, it was then subjected to alkali digestion using 2.5% NaOH solution (Indrayan *et al*., 2005). The residue was then ignited in furnace at 600 ^{0}C till ashing. For Crude

protein determination the sample was digested using digestion mixture of K_2SO_4 and $CuSO_4$ (8:1) and conc. H_2SO_4. The digested sample was subjected to distillation process using 40% NaOH and 4% Boric acid solutions, then it was titrated against 0.1N HCl solution. Ash was determined in muffle furnace at 660°C for an hour. Nitrogen Free Extract represents the digestible carbohydrates. This value was obtained by subtracting the sum of the percentages of moisture, crude protein, crude fat, ash and crude fiber from 100.

Mineral Determination

For mineral determination, acid digest was prepared using 10 ml perchloric acid ($HCLO_4$). Afterward spectrophotometer determination of phosphorus, iron, sodium and potassium was carried out using KH_2PO_4, $FeSO_4$, $(NH_4)_2SO_4.6H_2O$, NaCl, and KCl respectively.

Determination of starch content

Starch in selected samples was determined with ploax-2l polarimeter at PCSIR labs Peshawar.

Principle

Optically active compounds rotate the plane-polarized light. The degree and direction of rotation depends on the nature of the compound and its concentration. Degree and direction of rotation is determined by polarimeter.

Procedure

For the determination of starch in wheat 7.6 M HCl and 0.309M HCl, and two Carrez Solutions were required. Carrez Solution It was made by dissolving 21.9g zinc acetate dehydrate in water containing 3g acetic acid and volume made up to 100 ml. Carrez Solution II was made by dissolving Potassium ferrocyanide trihydrate in water and making the volume up to 100 ml.

Step-1: About 2.5 g of each dried sample was taken in 100 ml volumetric flasks. 25 ml of 0.309 M HCI was added in it. The flasks were shaken to obtain a proper distribution of the samples for analysis. Then further 25 ml of HCI was added. Flask was immersed on a boiling water bath for 15 minutes. In the 1st 3 minutes flask was shaken vigorously to avoid agglomeration. After 15 minutes flask was removed from water bath and add 30 ml of cold water in the sample. The sample was cooled to the temperature of 20°C then 5 ml of Carezz Solution-I was added and shaked. Then, 5 ml of Carrez-Solution-II was added and shaked for 1 minute. The solution volume was made up to the mark with water. The flask contents were mixed and then filtered. Then optical rotation of the filtrate was measured in 200 mm tube with the help of Polarimeter (Happi *et al.,* 2007).

STEP-2: Nearly 5g each sample were taken in 100ml volumetric flasks and 80ml of ethanol was added. The flasks were left to stand for 1 hr. at room temperature. During this time flasks were shaked vigorously 6

times. Then volume was made to the mark. After mixing the contents of flasks it was filtered. From the filtrate 50 ml was taken and 2.1 ml of 7.0 N Hcl was added to it (Bertler and Carlsson, 1958). The flasks were immersed on boiling water bath for 15 minutes. After 15 minutes the flasks were removed from water bath and volume was made up to 100 and cooled at room temperature. The samples were clarified by using Carrez Solution-I and -II. The contents were mixed and filtered. Optical rotation of the filtrate Percent starch was calculated using the given formula.

$$\% \text{ Starch} = \frac{2000\ (P-P')}{[\infty]\ 20^{o}\ D}$$

P = total rotation in degrees

P′ = rotation in degrees given by substances soluble in 40% ethanol.

$[\infty]\ 20^{o}\ D$ = specific rotation of pure starch. The generally accepted value for this fact is + 182.7^{o} for wheat starch.

RESULTS AND DISCUSSION

Wheat grains of six weeds infected varieties and one controlled variety were examined in the laboratories of Agricultural Chemistry department, The University of Agricultural Peshawar during 2005 for proximate composition and comparative study of different minerals, and starch contents, to evaluate their nutritional significance. The results show effect of weed on these nutrients contents of these wheat varieties.

Table-1 shows the proximate composition of selected wheat varieties. Moisture content of all varieties is in the range of 4.9% to 8.4%. It is greatest in Dera-91 and lowest in Pirsabak. Moisture content of wheat grains is important in several aspects. It is related to the quality as well as shelf life of grains. Too high or low moisture content of stored grains are undesirable. High moisture enhances growth of molds and other spoiling organisms to deteriorate quality while dry grains diminish the quality, appearance and demand of food products. Colyer *et al*. (1997) viewed that more than 14% moisture in wheat is undesirable and make grains more susceptible to fungal attacks. All samples were in safe range of moisture content. No variety exceeds the limit of 14%. Ash determines the mineral part of the wheat grains and it is very important from nutritional point of view because the highest amount indicates the mineral sufficiency of the variety (Indrayan *et al*., 2005). The present study indicated that the maximum ash contents (1.767%) were present in Khattakwal and minimum was in Ghaznavi (1.37%). However, variation among varieties is considered non significant. Wheat grains are widely used in all parts of the world and provide most part of proteins in human diet. It is shown that weed has no significant effect on the protein contents

of wheat grains. The crude proteins were lowest among the studied varieties ranging from 7.8% to 12.8%. Pirsabak having the lowest moisture has the highest proteins. Khattakwal was poor in protein contents comparatively as shown in Table-1. Wheat is not a good source of fats and a beneficial diet for people suffering from CVD. The crude fat value ranges from 1.0 to 1.60%. Saleem-2003, Dera-91 and Controlled were higher in this respect. Crude fibers were highest in weedy check variety (1.87%). Fibers help in digestion of food, and helps in enzymatic reactions and peristalsis movement (Tamime *et al*., 1999*)*. NFE ranges from 78.03 to 81.2% in all wheat varieties. The data indicates that wheat is a good source of proteins and all varieties provide a considerable amount of carbohydrates. Variations among varieties were not significant. Pirsabak was highest in protein contents and Khattakwal provides maximum carbohydrates. It is concluded that weed has no significant effect on proximate composition of different wheat varieties. The findings of this research will be confirmed through other trails.

Starch is very important in the sense of provision of energy. The data regarding starch contents is given in Table-1. Results show that wheat provides significant amount of starch. Controlled variety contains the greatest percentage of starch (76.6%) while affected varieties have a range of 30.0% to 52.5%. It is clear from the results that *Avena fatua* has significant effect on starch contents of wheat varieties (Table-1).

The elemental composition of different wheat varieties is given in Table-2. All varieties show little variation in minerals. Phosphorus was as high as 167mg $100g^{-1}$ in Fakhr-e-Sarhad and as low as 142 mg $100g^{-1}$ in controlled variety. Second abundant mineral found in wheat was Potassium. Sodium was also present in appreciable amount in all varieties. Maximum amount was found in Khattakwal (130mg $100g^{-1}$). All varieties have considerable quantity of iron, ranging from 106 mg $100g^{-1}$ to 119mg $100g^{-1}$. The highest amount was present in Pirsabak,similar findings are reported by Revely (1978). Minerals are very important for metabolism processes in the body. Phosphorus is necessary for the formation of bones (Ducy *et al*., 2000). Phosphorus is found in every cell of the body but most of it (about 80% of the total) is combined with calcium in the bones and teeth. About 10% is in combination with proteins, lipids, and carbohydrates and in other compounds in blood and muscles. The remaining 10% is widely distributed in various chemical compounds. Sodium is the major cations of the extra cellular fluids and maintains osmotic pressure of the body fluids and thus protects the body against excessive fluid loss. Potassium is the principal cation of the extra cellular fluid and a very important constituent of the extra cellular fluid because it influences

muscle activity, notably cardiac muscles (Klette *et al*., 1993). While iron is helpful for the formation of RBC (Hardold, 1987*)*. It is observed that wheat grains contain enough amounts of all the essential minerals and compound in the RDA of these selected minerals (Table-2).

The differences in proximate analysis are not always necessary to be due to genotype differences. The gene expression is the result of interaction between genotype and environment. Weeds compete with wheat crop for abiotic factors. If in the soil some salts, minerals etc. are deficient due to competition of weeds then the genotype expression will also be affected.

CONCLUSION

In conclusion, the moisture content ranged from 4.95 to 8.4% (the maximum amount was noted for Dera-91 variety. The protein content was highest in the variety of Pirsabak (12.89%). The content of fat ranged between 1.0 and 1.6%; however, the fiber, ash and NFE contents were in an appreciable amount in all varieties. Among the minerals, P was the highest and its concentration was from 120-167 $mg.100^{-1}g$ with the maximum amount (167) found in Fakhr-e-Sarhad. The iron (Fe) content was present in the range of 106-119 $mg.100^{-1}g$. The maximum amount of 119 $mg.100^{-1}g$ was observed in Pirsabak variety. The variety Khattakwal had the highest Na (130) and K contents (126 mg 100^{-1} g) whereas the weedy check had the lowest Na and K contents. In addition, weedy check showed the highest starch contents (76.6%). Thus, among the different wheat varieties no significant variation on nutrient composition was observed and therefore it can be concluded that weed has no significant effect on the nutritional quality of wheat grains.

Table-1. Proximate composition of wheat varieties (% on dry weight base) (Means ± SD)

Sample	Moisture	Proteins	Fats	Fibers	Ash	NFE	Energy	Starch
Khattakwal	5.04±0.02	9.57± 0.02	1.35±0.02	1.140±0.1	1.76±0.15	81.2±0.1	51.78±0.00	30±1.0
Ghazavi	5.09±0.01	11.97±0.01	1.42±0.07	1.5±0.1	1.37±0.02	78.57±0.01	264.82±0.02	49±1.0
Fakhr-e-Sarhad	5.19±0.01	7.837±5.8	1.5±0.1	1.0±0.02	1.62±0.01	79.52±0.01	272.94±0.02	52.3±0.52
Dera 91	8.4±0.05	9.57±0.03	1.0±0.02	1.6±0.1	1.43±0.01	78.03±0.06	232.2±0.01	44.8±0.1
Saleem 2003	6.28±2.31	10.37±0.02	1.45±0.02	1.5±0.1	1.47±0.01	80.26±0.01	271.2±0.01	52.5±0.1
Pirsabak	4.9±0.04	12.8±1.15	1.5±0.1	1.8±0.1	1.52±0.01	76.67±0.01	248.7±0.01	43.7±.01
Control (weed free)	5.30±0.1	11.17±0.03	1.601±0.1	1.87±0.01	1.58±0.01	78.48±0.01	374.7±0.01	76.6±0.1

Table-2. Concentration of minerals in various wheat varieties (mg.100g^{-1}) (Means ± SD)

Sample	Na	K	P	Fe
Khattakwal	130±1.0	152±1.0	157±1.0	108±1.0
Ghaznavi-98	125±1.0	139.5±0.1	147±1.0	108±1.0
Fakhr-e-Sarhad	105±1.0	147±1.0	167±1.0	110±1.0
Dera-91	105.2±0.1	143. ±1.0	164±1.0	106±1.0
Saleem-2003	102.5±0.1	134±1.0	155±1.0	117±1.0
Pirsabak	102±1.0	147±1.0	158±1.0	119±1.0
Control (weed free)	126±1.0	128±1.0	157±1.0	108±1.0

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