

PHYTIC ACID AND POTENTIAL NUTRIENTS IN WHEAT CORN AND SOYBEAN

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Different cultivars of wheat, corn and soybean were assayed for phytic acid, phytate phosphorus, and potential nutrients such as protein, fat, ash, fibre and total energy as well as selected mineral elements like iron and phosphorus. The data revealed that soybean contained significantly higher amounts of all nutrients as compared to corn and wheat. Significant difference in the nutrient contents was also observed among the cultivars of each crop. The concentration of phytic acid ranged between 0.9 and 1.2% in wheat, 0.7 to 0.9% in corn and 1.3 to 1.5% in soybean. The average value for the phytate phosphorus was the highest in soybean (429.6 mg) followed by wheat with (217.5 mg) and lowest in corn (197.2 mg) per 100 g.

INTRODUCTION

Wheat (*Triticum aestivum* L.), corn (*Zea mays* L.) and soybean (*Glycine max* L) are important foodgrain crops in Pakistan. Wheat is the main staple which provides an appreciable amount of food nutrients to the body. Corn is another important cereal crop, which is abundantly consumed in most parts of NWFP, as well as in some other parts of Pakistan. Soybean also occupies a prominent position in the world agriculture owing to its high content of protein, fat and other essential nutrients.

Although the composition of wheat, corn, and soybean has been reported by various investigators [1-4], yet little work has been done to evaluate the essential nutrients, particularly of phytic acid under the existing climatic conditions of NWFP. It has also been observed that variation in the environmental and agronomic factors has a greater influence on the concentration of various nutrients [5, 6]. Cereals and legumes, besides containing essential dietary nutrients, also possess physiologically important factors such as the phytates which could pose nutritional problems [7]. Phytates are of considerable dietary significance because they form complexes with certain divalent and trivalent metallic ions and proteins and in many cases from insoluble compounds which impede the absorption of minerals and lead to deficiency diseases.

In view of the nutritional significance of phytate and essential nutrients in cereals and legumes, the present investigation was initiated to determine the chemical com-

position, including some important minerals and phytic acid in the grains of different cultivars of wheat, corn and soybean.

MATERIALS AND METHODS

Collection of samples. Wheat cultivars (Khyber-79, Lyallpur-73 and Pak-81) were obtained from Agricultural Research Institute, Tarnab, Peshawar. Corn cultivars (Azam, New Shaheen and Sarhad Yellow) and soybean cultivars (Bragg, William and Woodworth) were procured from the Cereal Crop Research Station, Pirsabak, Nowshera and Agricultural Research Institute, Mingora, Swat respectively.

The seeds were ground in a Wiley mill and passed through a 20-mesh sieve to get the desirable flour. The flour of each cultivar was stored in a polyethylene bag for subsequent analysis.

Proximate composition. Moisture, crude protein, ether extract, and ash content were determined according to the A.O.A.C. methods of analysis [8]. Crude fibre content was determined by an alternate method of Jacobs [9].

Mineral and phytic acid analysis. The zinc content of wheat, corn and soybean was determined with an atomic absorption spectrophotometer according to the method of O. Dell *et al.* [3]. Iron and phosphorus contents were determined by the method described in AOAC [8]. Phytate phosphorus was determined according to the procedure of Wheeler and Ferrel [10]; while the phytic acid content was estimated from total phosphorus as described by Lolas *et al.* [2].

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RESULTS AND DISCUSSION

The results of the proximate composition of wheat, corn and soybean cultivars are presented in Table 1. The results show that the crude protein content of wheat cultivars ranged between 12.3 and 13.4%, the fat content varied from 1.6 to 1.8% and ash from 1.4 to 1.5%. The protein contents observed for the corn cultivars were lower than for wheat cultivars but higher in fat contents. Soybean cultivars showed higher amounts of protein, fat and ash contents as compared with wheat and corn. Statistical analysis also revealed that there were significant differences in the nutrient content of wheat, corn and soybean. Different cultivars of these crops also differed significantly for some of the nutrients, whereas for others they did not vary significantly.

However, variation in the environmental and agronomic factors could exert significant effect on the concentration of various nutrients. The results of the proximate composition of cereals and soybean are comparable with those reported by other investigators [2, 3].

The results of phytic acid and some of selected minerals in different cultivars of wheat are given in Table 2. The data revealed that the phytic acid content of different cultivars ranged between 0.9 to 1.2%, total phosphorus varied from

396.0 to 471.9 mg per 100 g, iron from 466.9 to 553.0 mg per 100 g, and zinc from 46.6 to 60.6 μg per g. The highest phytic acid, total phosphorus and zinc content were found in wheat cultivar Lyllpur-73, while the iron content was the highest in cultivar Pak-81. The highest coefficient of variability was found for zinc (12.9%), followed by phytic acid (9.5%) and total phosphorus (7.1%) and was the lowest for phytate phosphorus (1.5%). Table 2 also shows the results of the same parameter measured for the different cultivars of corn. The results indicate that the phytic acid of different cultivars of corn ranged between 0.7 to 0.9%; total phosphorus from 323.0 to 381.7 mg per 100 g; iron from 354.3 to 366.4 mg per 100 g; and zinc from 52.8 to 76.1 μg per g. Among the cultivars of corn Sarhad yellow showed the highest amount of phytic acid and total phosphorus, whereas iron and zinc contents were highest in the corn cultivar New Shaheen. The highest coefficient of variability was found for zinc (15.0%) followed by that of phytic acid (9.8%), and the lowest for iron (2.7%) and intermediate for other nutrients.

The results of different cultivars of soybean, viz. Bragg, William and Woodworth for phytic acid and other selected minerals are also shown in Table 2. It was found that the phytic acid content of these cultivars varied from 1.3 to 1.5%; total phosphorus from 712.3 to 769.9 mg per 100 g;

Table 1. Potential nutrients of different cultivars of wheat, corn and soybean

Crop	Cultivar	Moisture (%)	Crude protein (%)	Crude fat (%)	Ash (%)	Crude fibre (%)	Carbohydrates (%)	Energy (KCal/100g)
+								
Wheat	Khyber-79	12.3	13.4	1.6	1.4	2.1	81.6 a	408.4
	Lyallpur-73	11.7	12.3	1.7	1.4	2.0	82.7	408.9
	Pak-81	13.0	12.8	1.8	1.5	2.1	81.9 a	409.1
	Average	12.3	12.8	1.7	1.4	2.1	82.1	408.8
Corn	Azam	9.0	8.6	3.8	0.8	1.4	85.4 a	419.5
	New Shaheen	9.8	8.2	3.5	0.9	1.4	85.9	418.1
	Sarhad Yellow	12.7	7.8	4.0	1.0	1.7	85.5 a	419.3
	Average	10.5	8.2	3.8	0.9	1.5	85.6 b	419.3
Soybean	Bragg	8.4	40.2	20.8	4.9	2.2	32.0	511.8
	Williams	9.1	38.5	21.1	4.9	2.2	33.3	513.4
	Woodworth	9.8	39.5	19.0	5.0	2.1	34.4	502.5
	Average	9.1	39.4	20.3	4.9	2.2	33.2	509.2

* For each crop and each constituent values sharing common letter are not significantly different ($P < 0.05$).

Table 2. Phytic acid, phytate phosphorus and mineral elements of different cultivars of wheat, corn and soybean

Crop	Cultivar	Phytic acid %	Total phosphorus mg/100 g	Phytate mg/100 g	Phosphorus	Non-phytate phosphorus mg/100 g	Iron mg/100 g (mg/100 g)	Zinc ($\mu\text{g/g}$)
					(% of total phosphorus)			
Wheat	Khyber-79	0.9	396.0	224.7	64.7	71.5	466.9 a	46.6 a
	Lyalpur-73	1.2	471.9	217.7	52.2	253.2	470.7 a	60.6
	Pak-81	1.1	431.1	210.2	56.0	220.9	553.0	46.6 a
	Average	1.1	433.0	217.5	57.6	215.2	496.9	51.3
Corn	Azam	0.8	351.0	190.6	59.7 a	160.4	343.4	52.8
	New Shaheen	0.7	323.0	207.8	71.2	115.4	366.4	76.1
	Sarhad Yellow	0.9	381.7	193.2	58.1 a	188.5	354.3	71.5
	Average	0.8	351.9	197.2	63.0	154.8	354.7	66.8
Soybean	Bragg	1.4	712.3	409.2	62.7 a	303.1	504.6	55.0
	Williams	1.3	733.0	443.2	66.5	289.8	538.4	49.7
	Wood-Worth	1.5	769.9	436.5	62.9 a	333.4	498.9	40.4
	Average	1.4	738.4	429.6	64.0	308.8	514.0	48.3

For each crop and each constituent values sharing common letters are not significantly different ($P < 0.05$).

iron from 498.9 to 538.4 mg per 100 g and zinc from 40.4 to 55.0 μg per g. Soybean cultivars supercede in phytic acid and total phosphorus content over wheat and corn contents whereas corn showed superiority in zinc content over wheat and soybean. Estimation of the coefficient of variability for various nutrients of soybean cultivars revealed the highest value for zinc (41.8%), least for iron (3.4%) and intermediate values for other nutrients.

The present estimation for phytic acid in cereals and legumes is of great nutritional importance as it interacts with proteins, vitamins and impedes which impedes their absorption and consequently is a factor limiting the nutritive value of food [11].

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