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Nutritive Values and Phytate Content of Some New Varieties of Wheat and Legumes

Dipak Kumar Paul and [1]Ranajit Kumar Shaha
Department of Applied Nutrition and Food Science, Kushtia Islamic University, Bangladesh
[1]Department of Biochemistry and Molecular Biology, University of Rajshahi, Rajshahi 6205, Bangladesh

Abstract: The present study was to investigate the nutritive values such as moisture, ash, fibre, protein, fat, carbohydrate as well as Phytate and zinc content of different locally developed improved eleven varieties of wheat, four varieties of legumes. The nutritive values, Phytate and zinc content were analyzed by standard methods. Among all cereals and legumes sample studied, fat content varies from 1.9-3.12 g; protein content varies from 8.9-12.5 g and carbohydrate content varies from 58-71.3 g, respectively. From the study it is revealed Akbar variety of wheat content the highest amount of fat (3.12 g) and carbohydrate (72.5 g) and grass pea contain the highest amount of protein (28.2 g/100 g edible portion). Phytate and zinc contents of different varieties of wheat, legumes are studied. Among the tested samples grass pea was the highest Phytate content (745.5 mg/100 g edible portion). Zinc content was found in different wheat varieties (1.08-3.94 mg) and legumes (2.75-3.96 mg). Maximum content of zinc in legumes (grass peas, 3.96 mg) and wheat (kanchan and Gaurav varieties 3.94 mg). Maximum Phytate and zinc contents of whole-wheat flour were found 712 mg (Akbar variety) and 3.94 mg (kanchon and Gaurav varieties)/100 g edible portions, respectively. Phytate-zinc molar ratios ranged from 15.3-22.2 in different wheat varieties and 16.9-19.4 in legumes. Balaka variety of wheat contents the highest Phytate-zinc molar ratio (22.2). In this study, estimated Phytate-zinc molar ratio of Bangladeshi daily diet was found to be 12.7.

Key words: Wheat, improve varieties, nutritive value, phytate, zinc, molar ratio

INTRODUCTION

Bangladesh is one of the poor countries of the world. About eight percent of the population lives below poverty line[1]. Since the present nutritional status of most developing countries is not satisfactory, the need of nutrients rich food is given greater emphasis in these parts of this world[2]. Legume seeds are an important part of the human diet in South East Asia, the Near East and parts of East Africa[3,4]. Cereals contribute large amounts of this category foodstuff are included in the daily diet in Bangladeshi people. Rice, wheat and pulses are the main cereals grains and legumes consumed in here. They are the cheapest sources of calories[5]. Wheat and pulses are the cheap source, not only carbohydrate but also of protein. They are however important as carriers of vitamin E[6]. Phytate, myoinositol hexaphosphate or IP6, is a naturally occurring compound found in all seeds. In its native state it complexes with protein as well as divalent cations and is consumed by humans and animals chiefly in cereal grains and legumes or food derived from them. One function of Phytate in the seed is to serve as storage from of phosphorous[7]. During germination, phytase, which is present in most seeds, hydrolyzed phytate to release inorganic phosphate[8,9]. Zinc deficiency, once thought to be non-existent, is known to occur in several population[10,11]. An inverse relationship has been demonstrated between dietary Phytate and zinc bioavailability in several studies[10,12]. These ratios may be used when the potential bioavailability of dietary zinc in human is assessed[13,14]. In Bangladesh there has been very few studies carried out to determine the nutritive values of different food staff and informing mass people about the values of foods.

The present study as undertaken to determine the proximate composition namely moisture, ash, fiber, protein, fat, carbohydrate, Phytate and zinc content of some newly developed wheat and legumes to comparison the nutrient contents and Phytate-zinc contents in Bangladesh diet.

MATERIALS AND METHODS

Collection of samples: Seventeen samples of different varieties of Wheat, Lablab Bean seeds, Lentil and Grass pea, were collected from mid February to April 2002, for this study. Of the seventeen samples, eleven varieties of wheat samples namely Kanchon, Sonalica, Provati, Akbar,

Corresponding Author: Dipak Kumar Paul, Chairman, Department of Applied Nutrition and Food Science, Islamic University, Kushtia, Bangladesh

Gaurav, Barkat, Ananda, Pavon, Kheri, Balaka and Aghrani were collected from Bangladesh Agriculture Research Institute (BARI), Irshardi, Pabna. For experimental purposes the mature seeds of different cultivars of bean (Ipsha-1, Ipsha-2, Dolicos) were supplied from the department of Genetics and Breeding, Rajshahi University. Mature and good Lentil yellow (*Lens esculenta* L); Lentil brown (*Lens esculenta* L.) seeds were collected from Irshardi seed storage farm and Grass pea (*Lathyrus sativus* L) was collected from local market of Rajshahi City and were tested in this study. All the chemicals and solvents used in this study were analytical grade (Sigma and Merck Co.) and were purchased from local market.

Techniques used: Among all seventeen samples for analysis, eleven samples of wheat and six legumes were grinded in an electrical grinder machine (Jamboo, India). Samples of each variety were chemically analyzed to find their proximate values (moisture, ash, fibre, fat, protein, carbohydrate, Phytate and zinc). The moisture content was determined by drying the powder samples in an oven at 105°C for 5 h and expressed on a percentage basis[15]; ash content was determined through Straight Combustion Method (550 – 650°C) describe by Triebold and Aurand[16] and crude fibre content was determined by Anonymous[17]. Total lipid content was determined through Evaporating Method describe by Bligh and Dyer[18]. Kjeldahl Method as mentioned in AOAC [15] determined protein content and carbohydrate content was determined by subtracting the sum of the total value/100 g for moisture, ash, protein, fat and crude fibre from 100 according to Anonymous[17]. Phytate content was determined according to the method described by Wheeler and Ferrel[26]. For the estimation of zinc, powder sample (5 g) was wet ashes using a mixture of 18 M H_2SO_4, 12M HCl and 16 M HNO_3 (0.5:1.0:0.5 by volume)[19]. After dilution the concentration was determined by the use of an Atomic Absorption Spectrophotometer[20]. The millimole of phytic acid and zinc are calculated by dividing the mg of Phytate by 660 (Mol. wt. Phytic acid) and the mg of zinc by 65.4 (atomic weight of zinc). The molar ratio of phytic acid to zinc was then calculated by dividing millimoles of phytic acid by millimoles of zinc. From each variety, triplicate samples were taken and analyzed. Results are shown as mean±SD in g/100 g edible portion.

RESULTS

The proximate composition of moisture, ash and fibre content of the analyzed samples are represented in Table 1a, b and c. The moisture content of the wheat varieties studied was found to range between 9.95-12.40 g; bean varieties was found to range between 12.30-13.10 g and lentil and grass pea content between the range 10.51-12.50 g. Among wheat the lowest value of moisture in Kanchan (9.95±0.06 g) and the highest value Aghrani varieties (12.40±0.06 g); among bean lowest content value of moisture Ipsha-1 (12.30±0.06 g) and highest in Ipsha-2 (13.10±0.08 g); among lentil and grass peas lowest content of moisture in Grass pea (10.51±0.20 g) and highest in Lentil yellow (12.50±0.80 g), respectively.

Table 1a: Moisture, ash and fibre content of different verities of wheat (Values/100 g edible portion)

Varieties	Moisture (g)	Ash (g)	Fibre (g)
Kanchan	9.95±0.06	1.24±0.04	1.89±0.08
Sonalica	10.20±0.08	1.40±0.06	1.46±0.06
Provati	10.40±0.08	1.38±0.07	1.88±0.09
Akbar	10.06±0.04	1.46±0.04	2.01±0.10
Gaurav	12.30±0.06	1.70±0.20	1.90±0.07
Barkat	11.70±0.40	1.28±0.06	1.70±0.04
Ananda	10.51±0.20	1.49±0.40	1.69±0.09
Pavon	9.95±0.06	1.40±0.20	1.60±0.02
Kheri	10.20±0.08	1.62±0.06	1.70±0.05
Balaka	10.40±0.08	1.34±0.40	1.69±0.07
Aghrani	12.40±0.06	1.70±0.08	1.91±0.09

Table 1b: Moisture, ash and fibre content of different verities of Bean seeds (Values/100 g edible portion)

Name of variety	Moisture (g)	Ash (g)	Fibre (g)
Ipsha-1	12.3±0.06	1.70±0.08	1.90±0.09
Ipsha-2	13.1±0.08	2.70±0.03	1.48±0.10
Dolicos	12.8±0.07	2.10±0.08	1.98±0.06

Table 1c: Moisture, ash and fibre content of two verities of lentil and one variety of grass pea seeds (values/100 g edible portion)

Name of variety	Moisture (g)	Ash (g)	Fibre (g)
Lentil yellow (*lens esculenta* L.)	12.50±0.8	2.7±0.08	3.6±0.06
Lentil brown (*Lens esculenta* L.)	11.70±0.4	2.5±0.04	3.1±0.02
Grass pea (*Lathyrus sativus* L.)	10.51±0.2	2.7±0.20	3.3±0.05

Table 1a, b and c also show the ash and fibre content of different varieties of wheat and legumes. Ash content in wheat variety varied between (1.24±0.04 g) to (1.70±0.2 g), bean varied between Ipsha-1 (1.70±0.08 g) to Ipsha-2 (2.70±0.03 g). Ash content in lentil variety and grass peas varied between lentil (2.50±0.04-2.70±0.08 g) and grass peas (2.70±0.20 g). The fibre content in the wheat sample analyzed was found to range between Sonalica (1.46±0.06 g) to Akbar (2.01±0.10 g). Bean seeds content varied between Ipsha-2 (1.48±0.10 g) to Dolicas (1.98±0.06 g) and lentil and grass peas content varied between (3.10±0.02-3.6±0.06 g).

Protein, fat and carbohydrate contents of different varieties of wheat and legumes were represented in Table 2a and b. From present studied protein, fat and carbohydrate contents in different varieties of wheat varies from 8.9-12.5, 1.9-3.12 and 58.7-72.5 g,

Table 2a: Fat, protein, carbohydrate, phytate and zinc content of different verities of whole wheat (values/100 g edible portion)

Varieties	Fat (g)	Protein (g)	Carbohydrate (g)	Phytate (mg)	Zinc (mg)	Phytate: zinc molar ratio
Kanchon	2.96±0.21	10.90±0.24	69.9±5	680.0±2.9	3.94±0.08	17.1
Sonalica	2.76±0.33	11.09±0.43	71.3±12	590.0±3.1	3.88±0.04	15.3
Provati	2.38±0.18	11.90±0.94	70.8±8	692.9±3.6	3.58±0.06	19.2
Akbar	3.12±0.45	12.50±0.86	72.5±5	711.8±3.2	3.55±0.05	19.8
Gaurav	1.90±0.10	9.80±0.30	63.4±11	231.3±2.0	1.41±0.09	16.3
Barkat	2.30±0.20	8.90±0.23	61.8±9	341.9±1.2	1.90±0.07	17.8
Ananda	2.10±0.12	9.89±0.22	59.9±14	389.8±2.2	1.96±0.07	19.7
Pavon	1.98±0.31	8.97±0.14	58.7±6	265.2±1.9	1.66±0.04	15.8
Kheri	2.96±0.21	9.80±0.30	69.9±5	692.9±3.6	3.42±0.05	20.1
Balaka	1.90±0.10	11.09±0.43	69.9±5	241.2±1.2	1.08±0.03	22.2
Aghrani	2.76±0.33	10.90±0.24	69.9±5	680.0±2.9	3.94±0.05	17.2

Table 2b: Fat, protein, carbohydrate, phytate and zinc content of two verities of lentil and one variety of grass pea seeds (values/100 g edible portion)

Variety/Trade name	Fat (g)	Protein (g)	Carbohydrate (g)	Phytate (mg)	Zinc (mg)	Phytate: zinc molar ratio
Ipsha-1	1.5±0.10	27.05±0.3	47.5±3.0	602.4±2.8	3.24±0.03	18.4
Ipsha-2	1.4±0.30	26.03±0.2	48.6±6.0	611.5±1.9	3.17±0.06	19.4
Dolicos	1.7±0.10	27.06±0.2	50.8±4.0	741.2±3.1	3.89±0.02	19.0
Lentil yellow	1.4±0.60	24.20±0.8	62.1±2.4	475.9±1.2	2.80±0.06	16.9
Lentil brown	1.5±0.20	26.60±0.6	56.1±2.1	480.4±2.1	2.75±0.07	17.3
Grass pea	0.8±0.02	28.20±0.8	58.2±1.2	745.5±4.2	3.96±0.09	18.8

respectively. Legumes like peas content protein, fat and carbohydrate between 26.03-28.02, 1.4-1.7 and 47.5-50.8 g, respectively. Lentil and grass peas varied protein, fat and carbohydrate 24.2-28.2, 0.8-1.7 and 56.2-62.1 g, respectively.

Phytate and zinc content in different wheat varieties varies between 231.3-711.8 and 1.08-3.94 mg, respectively. Phytate and zinc content in different varieties Bean seeds between 602.4-741.2 and 3.17-3.89 mg. Lentil and grass peas content Phytate and zinc between 475.9-745.5 and 2.75-3.96 mg.

DISCUSSION

Moisture content of all analyzed samples varied between 9.95-13.10 g. Kanchan variety of wheat contents the lowest value of moisture (9.95 g) and lentil Ipsha-2 contents the highest (13.10 g). Ash content in wheat (kanchan) is the lowest (1.24 g), bean and lentil contents the highest amount (2.70 g). The fibre content in the sample analyzed was found to range between (1.46-3.60 g). Lentil contents the highest amount.

The content of protein of the samples analyzed ranges from 8.90-28.20 g. Fat content varied from (0.80-3.12 g) in the wheat and legumes. The highest amount of fat present in lentil varieties. The carbohydrate content of the samples was found to range from (47.50-72.50 g). Akbar variety of wheat contents the highest amount. The result obtained from the studied are more or less consistent with that of previous studies[5,21].

Among the tested samples grass pea and lentil were the highest Phytate content (745.5±4.0 and 741.2±3.1 mg/100 g edible portion). Zinc content was found in different wheat varieties 1.08–3.94 mg/100 g edible portion. Highest content of zinc in wheat kanchon and Gaurav (3.96 mg). Phytate-zinc molar ratios ranged from 15.3-22.2 in different wheat varieties and 16.9 -19.4 in legumes.

Table 3: Amount of Phytate and zinc present in food intake by Bangladesh adult

Food	Amount (g)	Phytate (mg)	Zinc (mg)	Phytate: zinc molar ratio
Rice	390.0	585.00	3.74	
Wheat	21.0	151.20	0.46	
Pulses	12.0	68.90	1.46	
Root and tubers	74.0	83.25	0.30	
Leafy vegetable	26.0	30.16	0.24	
Non leafy vegetable	87.0	100.92	0.49	
Fruits	15.0	17.40	0.29	12.83
Meat	9.0	0.00	0.22	
Fish	33.0	0.00	0.56	
Milk and Milk product	15.0	0.00	0.33	
Eggs	4.0	0.00	0.05	
Fat and oil	8.0	0.00	0.00	
Sugar	7.0	0.00	0.00	
Others	7.1	0.00	0.00	
Daily total	708.1	1036.83	8.14	12.83

Calculation :
Millimole Phytic acid : 1036.83 ÷ 660 = 1.57
Millimole Zinc : 8.14 ÷ 65.4 = 0.12
Molar Ratio (Phytate : Zinc) : 1.57 ÷ 0.12 = 12.83

In this study, Phytate and zinc content in different varieties of wheat, were very similar to that reported by Gopalan *et al.*[5]. Phytate content of legumes as reported in Nutritive value of Indian foods ranged between 300- 892.8 mg/100 g edible portions. Cereals and legumes have international level of zinc (0.5-3.2 mg/100 g). In the present study, zinc content of cereals and legumes were found in slightly high range as reported by other studies[5,22,23]. In this study, calculated mean zinc content of Bangladeshi diet was found to be 8.14 mg (Table 3).

Zinc composition was found in the range of 7-9 mg/day in the poorer region of the world[22]. The zinc intake of Bangladeshi population was comparable to that of the poorer region of the world. Daily average Phytate intake of Bangladeshi population was found to be 1036.83 mg (Table 3). Average American diet content Phytate per day ranging from 300-1300 mg[24]. South East Asian and South Africa diet content Phytate around 2200 mg/day[22]. So the Phytate content of Bangladeshi diet was found less than the average South East Asian and South Africa diet. A particular Phytate-zinc molar ratio of the foods may be useful for food selection. It is generally considered that diets with a Phytate-zinc molar ratio greater than 15 have relatively poor and Phytate-zinc molar ratio less than 15 have relatively good zinc bioavailability[25]. In this study, Phytate-zinc molar ratio of Bangladeshi daily diet was found to be 12.84.

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