Pak. J. Biochem. Mol. Biol., 2012; 45(3): 159-165

Effect of traditional cooking on proximate, mineral and phytic acid content in three rice varieties of Khyber Pakhtunkhwa, Pakistan

Arbab Riaz Khan[1, 2], Sahib Alam[1], Hameed Ullah Shah[1], Saeed Akhtar[2], Farid Ullah Khan Khattak[2] and Shams-ur-Rehman Afridi[2]*

[1]*Department of Agricultural Chemistry, KPK Agricultural University, Peshawar, Pakistan*
[2] *Food Technology Center, PCSIR Laboratories Complex, Peshawar, Pakistan*

Abstract: The proximate, minerals and phytic acid content of three rice varieties viz. YRL, Kashmir Basmati (K-B) and Swat-II (S-II) were studied in raw, soaked and boiled form in order to assess their role in human nutrition. It was observed that YRL, K-B and S-II in raw forms contained moisture content as 11.22, 12.4 and 12.4%, ash content; 1.73, 1.90 and 1.90% crude fat; 1.87, 1.53 and 1.53%, crude fiber; 0.89%, 0.90 and 0.90%, crude protein; 9.05, 7.92 and 7.92% and nitrogen free extract (NFE) 74.86, 75.35 and 66.35%, respectively. In soaked forms YRL, K-B and S-II varieties contained moisture content; 23.69, 27.2 and 31.47%, ash content, 1.73, 1.90 and 1.53%, crude fat; 1.90, 1.63 and 1.70% crude fiber; 0.85, 0.94 and 0.78%, crude protein; 8.91, 7.67 and 7.40% and NFE; 62.52, 60.52 and 56.75% respectively. In boiled forms of YRL, K-B and S-II the moisture contents were found to be 47.3, 40.56 and 60.34%, ash content; 1.43, 1.43 and 1.37%, crude fat; 1.70, 1.53 and 1.50%, crude fiber; 0.78, 0.72 and 0.88%, crude protein; 8.58, 8.11 and 7.01% and NFE; 38.68, 47.76 and 28.87% respectively. Average Chromium, Iron and Zinc, Manganese, Copper, Sodium, Potassium, Nickel and Phosphorous contents of YRL, K-B and S-II were found to be 26.67, 27.83 and 28.17mg/kg, 134.17, 141.72 and 139.67mg/kg, 25.56, 25.61 and 24.39mg/kg, 21.78, 23.00 and 25.67mg/kg, 16.06, 6.39 and 29.00mg/kg, 121.67, 241.67 and 247.78mg/kg, 789.44, 772.22 and 932.22mg/kg, 18.11, 13.44 and 13.44mg/kg, 732.89, 788.11 and 782.00mg/kg, 157.22, 156.11 and 221.11mg/kg respectively. Cooking methods significantly affected all the minerals except chromium which remained the same in both the raw and cooked forms. Phytic acid content of YRL ranged form 0.32 (boiled) to 1.16% (raw). Whereas that of K-B and S-II ranged from 0.51 (boiled) to 1.01% (raw) and 0.65 (boiled) to 1.05% (raw), respectively. It was concluded that cooking improved the nutritional quality of rice varieties.

Keywords: Mineral, rice, phytic acid, cooking, effect, rice.
Received: June 22, 2012 **Accepted:** August 15, 2012
***Author for Correspondence:** arkhan144@gmail.com

INTRODUCTION

Out of total food energy for the whole day about 20% is furnished by cereals[1] and rice is one of the most important cereals feeding half of the world population as a main food source[2]. In Pakistan rice is the second largest staple food after wheat and a major foreign exchange earning crop used as a food, livestock feed and raw material for industries. In Pakistan, it is grown on an area of 2581.2 thousand hectares with an average production of 5438.4 tones/ha. In KPK it is cultivated on area of 60.8 thousand hectares with and average production of 122.9 tones/ha[3].

It can be cooked through different procedures such as absorption method (enough water to cook it), rapid-boil method (large quantity of water that drained before serving and soaked prior to cooking method (to improves the texture of cooked rice). Specially, In Asian countries, Rice is consider as an important source of dietary protein for human and demand of it is expected to increase dramatically in future since the world population will be double by 2030[4]. Phytic acid is the hexa phosphoric ester of cyclohexan and widely distributed in commonly consumed foods[5]. Fox and Tao[6] narrated that phytic acid is usually found as a complex with essential minerals (Calcium, Iron, Phosphorus, Zinc etc) and proteins, and produce an adverse effect on the bioavailability and digestibility to human and monogastric animals which may leads to severe nutritional and consequently health problems in consuming population[7-9].

Therefore, this project is designed to rank the value of rice in human nutrition and its role to reduce the threat of malnutrition as well as under nutrients. Rice varieties are studied in raw, soaked and boiled form for proximate composition, mineral and phytic acid (anti-nutritional factor) content in order to assess their effect on nutritional profile.

MATERIALS AND METHODS

Sample collection and preparation

The present research was carried out in the department of Agricultural Chemistry KPK Agricultural University Peshawar and Pakistan Council for Scientific and Industrial Research (PCSIR) Peshawar, Pakistan. Three varieties of paddy rice (S-II, KB, YRL) were obtained from Agricultural Research Institute, Mingora Swat Pakistan. The samples were manually cleaned and de-husked, and then a composite sample was made from each variety. The samples were packed in paper bags, and stored at room temperature for further processing and analytical work. All the samples were analyzed after raw/uncooked, soaking and boiling cooking treatments.

Analytical work

Moisture was measured after drying at 105ºC for 24 hours in oven whereas, ash after heating to 550ºC for 6 hours in furnace[10]. Crude protein (CP) was analyzed using the kjeldahl standard method whereas; crude fat (CF) was determined through dry extraction method[10]. The crude fiber of moisture and fat free sample was estimated through digestion method using diluted H_2SO_4 and NaOH as described in AACC[10]. The nitrogen free extract (NFE) value was obtained by subtracting the sum of the percentages moisture, ash, CP, CF and crude fiber from 100. Energy value in calories was computed by multiplying the CP % by 4.1 and that of CF by 9.1[11].

For mineral analysis dried samples were first digested with nitric acid and perchloric acid and then the aliquots were used for the determination of sodium, potassium, calcium, magnesium and iron using Perkin Elmer atomic absorption spectrophotometer and flame photometer[10]. The sensitive method of Hang and Lantzsh[12] was adapted with little modification for the determination of phytic acid in given samples.

Statistical analysis

The data obtained were subject to two factorial Complete Randomize Design following least significant difference test and the significance levels were $P<0.05$[13].

RESULT AND DISCUSSION

The significant variation (SV) ($p<0.05$) was observed in MC among rice varieties and cooking methods. S-II was found for higher (34.74%) MC as compared to YRL (27.40%) and K-B (26.72%). Whereas, among the cooking methods, boiled form contained maximum (49.40%) MC with range of 47.30 to 60.34% followed by soaked form (27.45%) with a range of 23.69 to 31.47%. The MC of raw form ranged from 11.22 to 12.40% with an average of 12.01%. It is an important parameter for various foodstuffs because excess of moisture can promote bacterial growth, decay, molding or rotting. Our results are in agreement with Ali and Iftikhar [14] and Chughtai and Khan[15] who observed moisture for raw (10.5%) and boiled (71.5%) rice.

The ash of the raw, soaked and boiled forms of rice varieties is also presented in Figure 1. It is evident that there is no SV among the varieties but in cooking methods. Mean value of raw (1.84%) and soaked (1.72%) was found almost in same range for ash as compared to boiled (1.41%) form. The ash content reveals a cumulative picture of different minerals present in the food[16]. It contains metal salts, which are important for processes requiring ions and trace elements. The decrease in ash content due to boiling is might be due to their solubility in cooking water[17].

The data of crude protein (CP) of three rice varieties are evident that there is a SV among the varieties and treatments. YRL was found for higher mean value for PC (8.85%) followed by K-B (7.90%), whereas lower mean value (7.44%) was found for S-II.

Similarly, raw form found for higher mean value (8.30%) as compared to soaked (7.99%) and boiled (7.90%) form. Protein is essential parts of organisms and participates in every process within the cell and associated to form stable complexes[18]. It is evident from our results that there is SD in protein content among the varieties and treatments of selected rice. Our results are supports by Laila et al[19] who reported that raw milled rice varieties i.e. IR-43 and IR-45 contained 7.5 and 8.62% protein, while cooked milled rice flour contained 7.69 and 8.81% protein.

The data of crude fat (CF) shows that there are no SV among the varieties and treatments. Mean values for YRL, K-B and S-II were found 1.82, 1.57 and 1.58%, respectively whereas CF content ranged from 1.87 to 1.53%, 1.90 to 1.70% and 1.70 to 1.50% and the average being 1.64, 1.74 and 1.58% in raw, soaked and boiled form. Fat in diet is important and necessary source of energy. It provides more energy (9.3 Calories per gram) than both carbohydrates and proteins. Beside this, it also enhances the taste, aroma and texture of food and supplies human with essential fatty acids such as Lionleic acid and linolenic acid[11]. Our determined crude fat results are in line with that of Heinemann et al[20] and Habibullah et al[21].

The crude fiber result shows that there is no SV among the varieties but there is SV among the treatments. The raw (0.90%) and boiled (0.79%) form was found for almost same mean of crude fiber as compared to soaked (0.86%) form. Our results regarding to crude fiber is in agreement with Egounley and Aworh[22]. Crude Fiber in diet has been recognized as a healthy food component. Health benefits associated with adequate intake of these substances include: lower blood cholesterol and sugar levels, reduced risk of constipation, obesity, heart complications, colon and rectal cancer and hernia[23].

Table 1: Proximate composition of selected rice varieties in raw, soaked and boiled form. The standard errors are shown in parentheses (n=3)

Varieties	Moisture%	Ash%	CP%	CF%	Crude Fiber%	NFE%
Raw/uncooked						
YRL	11.22 (0.42)	1.73 (0.03)	9.05 (0.01)	2.26 (0.20)	0.89 (0.02)	74.86 (0.48)
K-B	12.40 (0.44)	1.90 (0.11)	7.92 (0.31)	1.53 (0.17)	0.90 (0.04)	75.35 (0.98)
S-II	12.40 (0.36)	1.89 (0.15)	8.77 (0.22)	2.16 (0.35)	0.81 (0.08)	74.54 (0.99)
Soaked						
YRL	23.69 (1,52)	1.99 (0.15)	8.91 (0.11)	1.90 (0.17)	0.85 (0.06)	62.52 (1.56)
K-B	27.20 (0.73)	1.90 (0.11)	7.67 (0.34)	1.63 (0.14)	0.94 (0.03)	60.66 (1.26)
S-II	31.47 (0.89)	1.53 (0.11)	7.40 (0.23)	1.70 (0.26)	0.78 (0.03)	56.75 (1.22)
Boiled						
YRL	47.30 (2.05)	1.43 (0.09)	8.58 (0.21)	1.53 (0.08)	0.78 (0.04)	40.38 (1.64)
K-B	40.56 (1.01)	1.31 (0.25)	8.11 (0,12)	1.53 (0.18)	0.72 (0.02)	47.76 (0.77)
S-II	60.34 (0.88)	1.40 (0.15)	7.01 (0,07)	1.50 (0.11)	0.88 (0.03)	28.87 (0.86)

For NFE, the SV was observed among the varieties and treatments. Both YRL (58.69%) and K-B (61.21%) were found in same range as compared to S-II (50.66%) whereas, raw form found higher for mean value (72.91%) for NFE as compared to soaked (59.93%) and boiled (38.44%) form. NFE represents the digestible carbohydrate, which are derivatives of polyhydric alcohols containing an aldehyde or ketone group and in man more than 60% of the total energy requirement is provided by the oxidation of carbohydrates. It is evident from results that uncooked rice contains less amount of moisture; give more NFE/100 g.

The selected samples were also evaluated for mineral composition i.e. Chromium (Cr), Iron (Fe), Zinc (Zn), Manganese (Mn), Copper (Cu), Sodium (Na), Potassium (K), Nickel (Ni), Phosphorus (P), Calcium (Ca), Cobalt (Co), Cadmium (cd) and Lead (Pb), and phytic acid. The minerals are very important for various biochemical and physiological processes occurring in the body and thus maintain the normal growth and health. The result of Cr content shows that there is no significant difference ($p<0.05$) among the varieties and treatments. The Cr in YRL, K-B and S-II were found to be 26.67, 27.83 and 28.17 mg/kg whereas row, soaked and boiled form contained 27.72, 28.06 and 26.89 mg/kg respectively. Cr needs in human diet is not fully understood, since no chromium containing bio-molecules with beneficial effects have been characterized. Beside this, there was no significant difference in Cr content among treatments and varieties of selected rice varieties.

It was observed that no significant variations existed among the varieties but cooking methods significantly affected the Fe contents of selected rice varieties. Soaked form contained higher amount of Fe (146.94mg/kg) while the boiled form contained minimum (128.44mg/kg). For Fe, our results are fairly in line with that of Laila et al[19].

Fe presented in meat is more easily absorbed than vegetable and deficiency can lead to Iron deficiency anemia. The Zn content of selected rice varieties and treatments explained that there is no SD exists among rice varieties but there is significant difference among the cooking methods. Raw form contained higher mean value of Zn (33.56mg/kg) followed by soaked form (24.94mg/kg) whereas boiled form contained minimum amount of Zn (17.06mg/kg).

For Zn content, there were no SD exists among rice varieties but in treatments. It is essential trace element necessary for sustaining all animal life and is thought to help plants resist drought and diseases and beside this, Zn containing enzymes are used by the body to regulate growth and development, fertility and nucleic acid synthesis.

Maximum Mn content (25.67mg/kg) was found in S-II while minimum (21.78mg/kg) in YRL but on the average there were no SD among the selected rice varieties whereas, SD was found for cooking methods. Maximum Mn content was observed in raw form (33.11mg/kg), followed by soaked form (20.89mg/kg) whereas, boiled form showed minimum Mn (16.44mg/kg).

Table 2: Mineral analysis of selected rice varieties in raw, soaked and boiled form. The standard errors are shown in parentheses (n=3)

Varieties	Cr	Fe	Zn	Mn	Cu	Na	K	Ni	P
Raw/uncooked									
YRL	0.55(0.02)	2.75(0.02)	0.74 (0.15)	0.61 (0.07)	0.58 (0.02)	2.63 (0.13)	28.30 (1.30)	0.59 (0.04)	0.80 (0.05)
K-B	0.57 (0.03)	3.13 (0.10)	0.69 (0.05)	0.65 (0.03)	0.15 (0.02)	5.00 (0.36)	26.97 (1.57)	0.29(0.02)	1.02 (0.02)
S-II	0.54 (0.01)	2.49 (0.04)	0.59 (0.02)	0.72 (0.04)	0.64 (0.01)	6.23 (0.63)	29.20 (0.56)	0.27 (0.01)	0.94 (0.05)
Soaked									
YRL	0.53 (0.02)	2.83 (0.04)	0.48 (0.02)	0.42 (0.03)	0.16 (0.02)	2.10 (0.20)	12.13 (0.73)	0.25 (0.01)	1.35 (0.15)
K-B	0.58 (0.03)	3.06 (0.10)	0.56 (0.04)	0.40 (0.01)	0.14 (0.01)	4.73 (0.26)	11.27 (0.41)	0.25 (0.01)	0.81 (0.08)
S-II	0.58 (0.02)	2.97 (0.06)	0.41 (0.01)	0.44 (0.02)	0.16 (0.01)	4.93 (0.21)	14.07 (0.14)	0.25 (0.02)	1.03 (0.03)
Boiled									
YRL	0.52 (0.04)	2.47 (0.21)	0.31 (0.02)	0.28 (0.02)	0.18 (0.04)	2.57 (0.27)	6.93 (0.24)	0.25 (0.02)	0.45 (0.04)
K-B	0.52 (0.02)	2.32 (0.26)	0.29 (0.04)	0.33 (0.04)	0.10 (0.01)	4.77 (0.35)	8.10 (0.49)	0.26 (0.02)	0.69 (0.04)
S-II	0.57 (0.01)	2.92 (0.16)	0.42 (0.01)	0.38 (0.03)	0.93 (0.05)	3.37 (0.29)	12.67 (0.38)	0.29 (0.03)	0.62 (0.03)

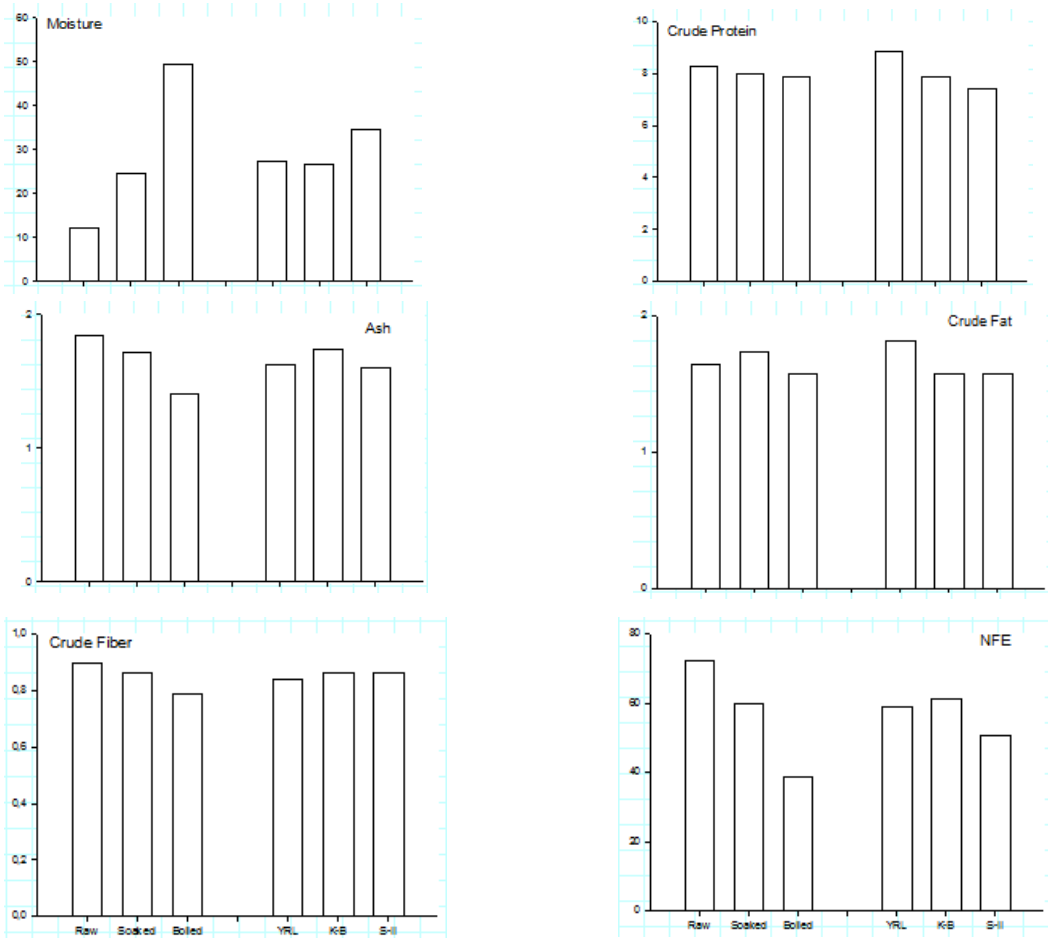

Figure 1: Proximate composition (%) of selected rice varieties as affected by different treatments.

Mn is an essential trace nutrient in all forms of life. Human body contains about 10 mg of Mn, which is stored mainly in the liver and kidneys. There are several enzymes that have Mn as a co-factor. The present study results shows that Mn content significantly decreased in rice varieties due to soaking or boiling and it may be due to its solubility in water. For Cu, significant variation exists among the varieties and cooking methods. S-II was found for higher (29.00mg/kg) Cu content followed by YRL (16.06mg/kg) whereas, K-B contained lowest (6.39mg/kg). Among the cooking methods, raw (22.83mg/kg) and boiled (20.89mg/kg) form showed the same amount of Cu whereas the soaked (7.72mg/kg) rice contained significantly less amount. Cu is also an essential in all plants and organisms. The human body normally contains copper at a level of about 1.4 to 2.1 mg for each kg of body weight and mainly occurs in liver, muscles and bones. The selected varieties have shown SD in Cu content from each other. The data of Na explained that significant variation exists among the rice varieties and also in cooking methods. K-B and S-II contained 241.67mg/kg and 247.78 mg/kg Na respectively whereas YRL contained much less amount (121.67mg/kg) of Na. Raw samples contained maximum (231.11mg/kg) content of Na whereas soaked (196.11 mg/kg) and boiled (183.89mg/kg) rice samples contained significantly ($P<0.05$) lower amount of Na. Na ions are necessary for regulation of blood and body fluids, transmission of nerve impulses, heart activity and certain metabolic functions and the results of the present study are supported by Anjum et al[24] who found similar contents of Na in parboiled rice.

The figure 2 shows the K content of selected rice varieties in raw, soaked and boiled forms. Significant variation exists among the varieties and cooking methods. S-II contained maximum (932.22mg/kg) content of K whereas YRL and K-B contained 789.44mg/kg and 722.22 mg/kg respectively. Raw samples contained maximum (1407.78mg/kg) content of K followed by soaked (624.44mg/kg) whereas boiled form contained lowest (461.67mg/kg). K content has been significantly decreased during soaking and boiling treatment as compare to raw form. K ions are necessary for human health and life for example, Potassium chloride is used to reduce sodium intake so as to control hypertension. The data on Ni content is also presented in figure 2. Significant variations ($p<0.05$) were observed among the rice varieties and in cooking methods. YRL was found for higher (18.11mg/kg) Ni content whereas K-B and S-II were found for same amount (13.44mg/kg). Among the cooking methods, raw form contained maximum (19.11mg/kg) Ni, whereas soaked (12.61mg/kg) and boiled (13.28mg/kg) rice contained almost same amount of Ni. SD has been found in present study for Ni among treatments and varieties. It plays important role in the biology of micro-organisms and plants.

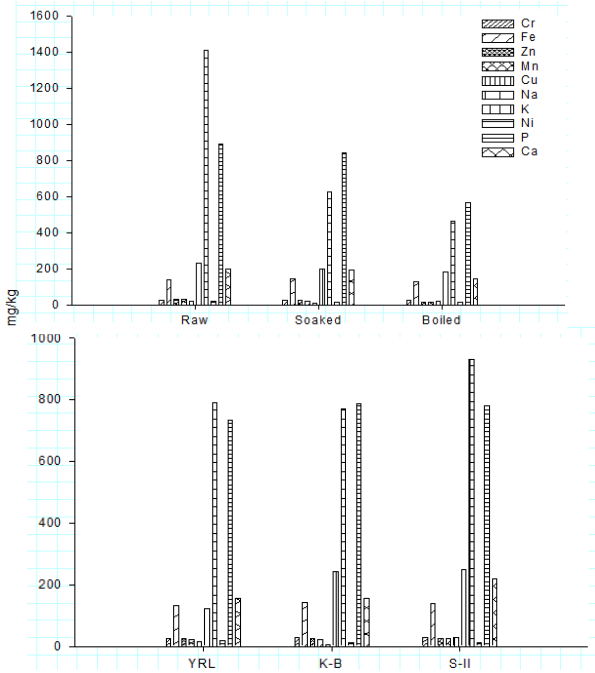

Figure 2: Mineral determination (mg/kg) in selected rice varieties and treatments.

The data presented in figure 2 shows the mean value of P content of rice varieties in raw, soaked and boiled form. According to data no SD exists among the rice varieties but there were SD among the cooking methods. Raw (893.11mg/kg) and soaked (843.22mg/kg) rice contained the same amount of P whereas the boiled (566.67mg/kg) rice contained significantly less amount of it. For P, no SD existed among the rice varieties but among treatments. These finding are higher than Hussain[25] who found Phosphorus content in wheat. The differences in the phosphorus may be due to the genetic variation of different cultivars. Inorganic phosphorus in the form of the phosphate PO_4 plays a major role in DNA and RNA and living cells also use phosphate to transport cellular energy via adenosine triphosphate (ATP). Ca results explain that there is significant variation among the varieties and cooking methods. S-II contained maximum (221.11mg/kg) content of Ca then YRL

(157.22mg/kg) and K-B (156.11mg/kg). Among the cooking methods, raw and soaked rice contained same mean for Ca content whereas boiled rice contained significantly less amount of Ca. The SD exists among treatments and selected rice varieties for Ca content. These finding are somewhat similar to those of Toma and Tabekhia[26] and Laila et al[19]. However Ali and Iftikar[14] reported low amount of calcium in cooked rice. Calcium is an important component of a healthy diet. Its play an important role in building stronger, denser bones early in life and keeping bones stronger and healthy later in life. Approximately ninety nine percent of the body's calcium is stored in the bones and teeth.

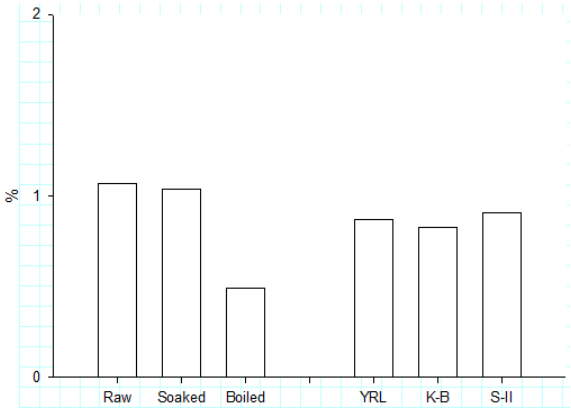

Figure 3: Phytic acid (%) in selected rice varieties and treatments.

The data on Phytic acid of selected rice varieties in raw, soaked and boiled form are also given in figure 3. It is evident that there was no SD among the varieties as compared to treatments. The average phytic acid contents of YRL, K-B and S-II were found to be 0.87, 0.83 and 0.91% respectively. The raw (1.07%) and soaked (1.04%) form was found in almost same mean value as compared to boiled (0.49%) form. Mamessh and Tomar[27] have reported phytate content in different rice varieties up to 0.22% that is lower then our results. Phytic acid is a strong chelator of important minerals such as calcium, magnesium, iron and Zinc. Therefore it's contributed to mineral deficiencies in people whose diets rely on these foods for their mineral intake, such as those in developing countries[28].

The figure 3 presents the data of (kilo-Calories) Kcal of selected rice varieties in raw, soaked and boiled form. According to which there is significant difference among the varieties and treatments. S-II had low mean value of 534.33 Kcal as compared to YRL (588.10Kcal) and K-B (600.22Kcal). Raw form had higher mean value (734.48Kcal) than Soaked and Boiled forms. Our results indicate that raw form had higher mean value (734.48Kcal) than soaked and boiled forms. These results are also supported by Habib et al[21] who found Kcal in mung bean. Kilo-calories are actually food energy which derived from protein, carbohydrates and fat[11]. It's generally measure the energy released when food is metabolized by a healthy organism. 1.0gm of protein and carbohydrate contribute 4.1calories whereas 1.0 gm of fat contributes 9.3calories. For phytic acid content, raw and soaked form were found in almost same mean value as compared to boiled form.

CONCLUSION

Moisture contents of all varieties significantly increased with soaking and boiling whereas, ash found higher in raw and soaked form as compared to boiled form. There was no significant effect of treatments (soak and boil) on crude fat, crude fiber and crude protein content of selected rice varieties. The analyzed rice varieties contained maximum NFE and Kcal in raw form as compared to soaked and boiled form. Our results showed that soaking and boiling significantly affects the most of mineral and Phytic acid content of selected rice varieties. Co, cd and Pb content are nil in mentioned rice varieties and according to nutritional point of view, Swat-II was found best. Theses results revealed that rice could meet the human mineral requirement.

REFERENCES

1. Orzaez MA and Quintela CCF. Sustancias antinutritivas enalimentos de origin vegetal. Su significado en la alimentacion humana. *Alimentaria*, 1995; 6: 115-120.
2. Shimamoto K. The molecular biology of rice. *J. Sci.*, 1995; 270: 1772-1773.
3. ASP (Agricultural statistics of Pakistan). 2006-2007. Government of Pakistan, Ministry of food, Agric. Livestock div. (econ wing), Islamabad.
4. Mann C. Reseeding the green revolution. *J. Sci.*, 1997; 277: 1038-1043.
5. Alabaster O, Tang Z and Shivapukar N. Dietary fibers and the chemo preventive modulation of colon carcinogenesis. *Mut. Res.*, 1996; 350: 185-197.
6. Fox MRS and Tao SH. Anti-nutritive effective effects of phytate and other phosphorylated derivatives. *Nutr. Toxicol.*,.1989; 3: 59-62.
7. Smith AK and Circle SJ. Soyabean Chemistry and Technoloy. Avi. Public Comp. Inc. Westport, 1978; 1: 110-118.
8. Maga JA. Phytate, its chemistry, occurrence, food reactions, nutritional significance and methods of analysis. *J. Agric. Food Chem.*, 1982; 30: 1-9.
9. Thompson LU. Reduction of PA in Protein isolates by aclyation techniques. *J. Am. Oil Chem. Soc.*, 1987; 64: 712-717.

10. AACC (Approved method of America Association of Cereals Chemists). 2000. St. Pauls Minnessota, USA.
11. Khalil IA and Manan F. Chemistry-One (Bio-Analytical Chemistry) 2nd edition, 1990; Taj kutab khana Peshawar.
12. Haug W and Lautzsch HJ. Sensitive Methods for the rapid determination of phytate in cereal products. *J. Sci. Food Agi.*, 1983; 34: 1423-1426.
13. Steel RGD and Torrie JH. Principle and Procedures of statistics. Mc. Graw Hill Book Co., 1997; New York.
14. Ali SM and Iftikhar AR. Nutritive value of indigenous cooked foods. *Pak. J. Sci.*, 1964; 16: 30-34.
15. Chughtai MID and Khan AW. Protein problems of Pakistan. Report of the protein committee. *Pub. Nat. Sci. Cong. Pak.*, 1986; 101.
16. Miraj G, Akhtar S, Khan AR, Ullah Z, Bibi S and Ali S. Quality evaluation of different honey samples produced in Peshawar valley. *Pak. J. Biol. Sci.*, 2008; 11: 797-800.
17. Mubarak AE. Nutritional composition and anti-nutritional factors of mung bean seeds as affected by some home tradiotional process. *Food Chem.*, 2005; 89: 489-495.
18. Maton A, Hopkins CW, McLaughlin S, Johoson M, Warner Q, Lattart D and JD Wright. Human Biology and Health Englewood Cliffs, New Jersey, 1993; USA: Prentice Hall.
19. Laila AE, Shekib ME, Youseef MM and Sarfwat MM. Effect of cooking on the chemical composition of lentils, rice and theirs blend. *Food Chem.*, 1986; 18: 163-168.
20. Heinemann RJB, Ragundes PL, Pinto EA, Pewnteado MC, Landfermarquez UM. Comparitive study of nutrients composition of commercial brown, parboiled and milled rice from brazil. *J. of Food Compos. Anal.*, 2005; 18: 287-296.
21. Habibullah MA and Shah HU. Proximate and mineral composition of mungbean. *Sarhad J. Agric.*, 2007; 23: 463-466
22. Egounley M and Aworh OC. Effect of soaking, dehulling, cooking and fermentation with Rhizopus oligosporus on the oligosaccharides, trypsin inhibitor, phytic acid and tannins of soybean (*Glycine max Merr.*) cowea (*Vigna unguiculata L. Walp*) and ground bean (*Marcrotyloma goecarpa harms*) Dept. Nutr. Sci. Dept. Food. Tech., Uni. Ibadan, Nigeria. *J. Food Eng.*, 2003; 56:249-254.
23. ADA. Health implications of dietary fiber. *J. Am.. Diet. Assoc.*, 2007; 97: 1157-1159.
24. Anjum FM, Minhas SI and Akhtar S. Chemical compositions and cooking quality of some rice cultivars in Pakistan as affected by parboiling. *Pak. J. Food Sci., 2003;* 13: 47-50.
25. Hussain T. Composition of food per 100gm of edible protein, proximate composition, minerals and vitamins. Food composition Table for Pakistan. Deptt. Agric. Chem. Humn. Nutri. NWFP Agric. Uni. Pesh., 1985; 14-17.
26. Toma RB and Tabekhia MM. Changes in mineral elements and phytic acid contents during cooking of three Californica rice varieties. *J. Food Sci.*, 1979; 44: 619-621.
27. Mameesh MS and Tomar M. Phytate content of some popular Kuwaiti foods. *Cereal Chem., 1993;* 70: 502-503.
28. Hurrell RF. Influence of vegetable protein sources on trace element and mineral bioavailability. *J. Nutr.*, 2003; 133: 2973-2977.