A QUANTITATIVE ANALYSIS AND COMPARISON OF NITROGEN, POTASSIUM AND PHOSPHORUS IN RICE HUSK AND WHEAT BRAN SAMPLES

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Abstract

The present study was conducted to perform quantitative analysis and comparison of Nitrogen, Potassium and Phosphorus contents in rice husk and wheat bran samples. Rice and wheat are leading staple food and are cultivated in Pakistan at large scale. During refining process the rice husk and wheat bran are removed from rice and wheat grains. Both rice husk and wheat bran contain nutrients in specific proportion, that’s why these can be used effectively for different purposes such as soil amendment and organic fertilizer to retain yield and increase soil fertility. In this study the detection of Nitrogen in rice husk and wheat bran samples was done by using elemental analyzer, Potassium detection was done by using Atomic Absorption Spectrophotometer and Phosphorus was detected by using X-Ray Fluorescence Spectrometry. The result of this study shows that rice husk contains more Nitrogen (0.476±0.0687) and Phosphorus (0.050±0.0072) contents as compared to wheat bran (0.410±0.0679) and (0.010±0.0038) respectively. However in wheat bran, Potassium content (26.706±2.47) was slightly higher than rice husk (25.986±1.573). It can be concluded that rice husk contains comparatively more nutrient value as eco-friendly organic fertilizer than wheat bran.

Key words: Rice husk; heat bran; Organic fertilizer; NPK; Soil Amendments

Introduction

Rice (Oryza sativa L.) is the most consumed staple food in the world. It is the second largest amount of any grain produced in the world. Rice is one of the most important cereal crops in Pakistan and it occupies almost 10% of total food production and it is an export earning commodity. Wheat is one of the premier food crops and staple food of the majority population of Pakistan. In Pakistan, wheat contributes 14.4 percent to the value added agriculture and 3.1 percent to GDP. Wheat was cultivated on an area of 9,042 thousand hectares in 2010 [1].

During rice refining processes, the husks are removed from grains. Because of its high silicon dioxide content; it is not useful to feed either human or cattle. Incorporation of rice husk into soil mixture was found to affect many crops [2]. Rice- husk has variously been used both as an amendment to improve crop yield and can be effectively used as fertilizer incorporation with other organic materials. The significance of Nitrogen, Phosphorus and Potassium are essential macro nutrient whereas Phosphorus is essentially significant for plant growth and reproduction [3].

Wheat bran, a by-product of flour milling is composed of the pericarp and the outermost tissues of the seed. Continued crop production can gradually decrease the organic matter content of soils and, hence, soil fertility and crop yields. Applying ash and animal waste to farmland after recycling has been one effective way to improve the physical, chemical and microbiological properties of soils. Ash improves soil texture, bulk density, permeability, water holding capacity/porosity/aeration, fertility status, resistance to pest attack, and reduces crust formation [4].

Use of chemical fertilizers and pesticides increase the crop yields but at the same time these are harmful and toxic to the environment [5]. Since the rice husk and wheat bran are locally available low cost organic matters, its utilization as high nutritional value fertilizer can be a good source to suggest alternatives to chemical fertilizers to reduce health hazards. The present study was conducted to detect nitrogen, phosphorus and potassium contents in risk husk and wheat bran samples were collected from various factories along the Grand Trunk Road (G.T. Road), Lahore.

Materials and Methods

The present study was carried out to detect and compare the nitrogen, potassium and phosphorus content in the samples of rice husk and wheat bran collected from different rice mills and flour mills located along G.T Road Lahore. Three samples from each mill were collected every month during the three month period of study. Rice samples were collected from Al Rasheed Rice Mill, M.J.M Rice Mill and Khan Rice Mill whereas wheat bran samples were collected from Sartaj Flour Mill, Bhatti Flour Mill and Datta Flour Mill.

Preparation of Ash of rice husk and wheat bran samples

Rice husk and wheat bran samples were weighed about 1 gram. One gram of each sample was placed in crucible and heated at 500°C for 10 to 12 hours in furnace until the sample was transformed into ash [6].

Detection of Potassium content by Atomic Absorption Spectrophotometer

Ash of each sample was moisturized with few drops of distilled water. After this it was mixed with 2 ml concentrated Hydro Chloric Acid (HCL, 80%) and then dried on hot plate at 100°C. Then it was mixed with 5 ml nitric acid (20%). The mixture was filtered by using Whatman filter paper into volumetric flask. Filtrate was ready for analysis at atomic absorption spectroscopy.

Filtrate was used to detect the potassium concentration in samples of rice husk and wheat bran. Each sample of rice husk and wheat bran was analyzed on flame mode of atomic absorption spectroscopy. Calibrations were performed at beginning of analysis to ensure that Atomic Absorption Spectroscopy was working properly. One blank solution and three standard solutions were used for calibration. After this sample was injected into Atomic Absorption Spectroscopy through small capillary. The amount of light absorbed by sample was proportional to concentration of absorbing species (Beer’s law). The detector then measured the light intensity and the absorbance of solutions and unknown concentration was measured directly by a read out system within the instrument from the calibration curve.

Detection of Nitrogen contents by Elemental Analyzer

Nitrogen in samples of rice husk and wheat bran was detected by the elemental analyzer. All samples were weighed about 2 grams using micro balance. Aluminum foil was taken and samples were properly wrapped with the help of aluminum foil. After folding, the sample was placed in auto sampler. Calibration was done using the standard solution Lysine Amino Acid. After completion of analysis the concentration of nitrogen was displayed on the readout system of the instrument.
Detection of Phosphorus by using X-Ray Fluorescence Spectrometry (XRF)

Detection of phosphorus was done by using XRF. Rice husk and wheat bran samples in ash form were used to detect the phosphorus on XRF. The sample was prepared as a flat disc. Samples were located at a standardized, small distance from the tube window. Ashes were machined to shape and finely ground and pressed into a tablet. Because the X-ray intensity follows an inverse-square law, the tolerance for this placement and for the flatness of the surface must be very tight in order to maintain a repeatable X-ray flux. It was necessary to ensure that the samples were sufficiently thick to absorb the entire primary beam. After running the process, the concentration of phosphorus was measured by readout system of instrument. Mean ± Standard Error Mean (SEM) for all parameters were completed and compared with T-Test through computer software Minitab 13 version.

Results and Discussion

Comparison of mean nitrogen, phosphorus and potassium contents in rice husk and wheat bran samples have been shown in table 1. High mean value of nitrogen and phosphorus samples was found in rice husk samples which are 0.476±0.0687 and 0.0504±0.007211 respectively. In wheat bran samples the potassium content was slightly higher than rice husk. Potassium content was found higher in wheat bran samples. T-Test value of rice husk and wheat bran samples was found to be non-significant. T-Test value of Phosphorus in rice husk was > 0.005, found to be significantly high. T-Test value of Potassium in wheat bran was to be 0.001 found to be significantly high.

Comparison between nitrogen concentration in rice husk and wheat bran samples are shown in Table 1 Results indicate that Nitrogen was found slightly higher in rice husk samples as compared to wheat bran samples. Finding of Basu et al. [7] showed that soil biological parameters were controlled by short term application of manures and fertilizers along with soil ameliorants (rice husk ash). According to their study that nitrogen in Rice husk ash was 0.06%. In present study the average concentration of nitrogen content found in rice husk was 0.476±0.0687%. Nwite et al. [8] report that nitrogen in Rice husk ash was 0.056% and rice husk ash can be effectively used as a soil amendment for improving the nutrient status as compared to wood ash and leaf ash. The possible reason of high value of Nitrogen and Phosphorus in rice husk might be the excessive use of Nitro-Phosphorus fertilizers (chemical fertilizers) during rice cultivation along with water as compared to wheat crop.

Phosphorus was found much higher in rice husk samples as compared to wheat bran samples. In case of Phosphorus, it was noted that Phosphorus content of all the rice husk samples was higher than the wheat bran samples. It was noted that the average phosphorus content of rice husk was found 0.0504±0.007211%. It was found that the average phosphorus content of wheat bran was 0.0101±0.00387%. It was observed that rice husk samples contained higher average value of phosphorus content as compare to wheat bran samples. T-test value of rice husk was found significantly higher than that of wheat bran samples.

Wheat bran samples have high value of Potassium contents as compared to rice husk samples. Basu et al [7] found in their study that potassium content in rice husk was 0.14%. It was observed that in all samples collected from different mills was slightly higher than rice husk sample. The average content of potassium in rice husk was found 25.98±1.573 mg/g. While the average content of potassium found in wheat bran was 26.70±2.47 mg/g. In the present study the average potassium concentration was slightly higher in wheat bran samples than rice husk samples. T-test value of rice husk and wheat bran was found significant. Hashim et al. [9] studied the nutrient content in Rice Husk Ash. The range of Potassium content in rice husk ash was 0.87% to 1.50%. These findings suggested the rice husk ash is a potential supplementary fertilizer source, convenient for paddy cultivation. In present study variation of nutrient contents occurred between the ashes of rice husk samples and wheat bran samples. Overall the average nitrogen and phosphorus content of rice husk samples was higher than the wheat bran samples. Whereas the average potassium content of wheat bran samples was slightly higher as compared to rice husk samples.

Table 1 Comparison of mean values of Nitrogen, Phosphorus and Potassium in wheat bran and rice husk samples.

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Nitrogen (Mean± SD)</th>
<th>Phosphorus (Mean± SD)</th>
<th>Potassium (mg/g) (Mean± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat Bran</td>
<td>0.410±0.0068</td>
<td>0.0101±0.0004</td>
<td>26.706±2.47</td>
</tr>
<tr>
<td>Rice Husk</td>
<td>0.476±0.0369</td>
<td>0.0504±0.0007</td>
<td>25.98±1.57</td>
</tr>
</tbody>
</table>

Conclusion:

In the present study the concentration of nitrogen, phosphorus and potassium was detected using the different instruments such as Atomic Absorption Spectroscopy, Elemental Analyzer and X Ray Fluorescence Spectrophotometer. This study suggests that the concentration of nitrogen and phosphorus is higher in rice husk as compared to wheat bran, while the potassium content is comparatively higher in wheat bran as compared to rice husk. Nitrogen, Potassium and Phosphorus are the important elements required for soil productivity. It is recommended that rice husk can be effectively used as soil amendments as compared to wheat bran due to its high nutritional value.

References