RESEARCH PAPER

Analysis of Sodium, Potassium, Calcium and Lithium in some wheat varieties grown in Balochistan

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Abstract

Minerals are essential elements of the human diet, assisting in cellular body processes from rebuilding tissue to maintaining ion gradients. This study was carried out to estimate various minerals like calcium, potassium, sodium and lithium in wheat varieties grown in Balochistan, Pakistan. Twenty wheat samples were collected from Balochistan Agriculture Research Centre Quetta. Minerals were determined by flame photometry. The highest concentration of sodium was 4.2 ppm which is still less than the recommended value that is 4.8 ppm. Adequate amount of calcium upto 3.9 ppm was observed which is lower than the recommended value of 7.2 ppm. Potassium concentration of 3.5 ppm was found which is quite lower than the recommended value that is 7.8 ppm. Only one wheat variety showed slightly higher lithium level of 0.25 ppm as compared to the recommended value that is 0.24 ppm. The results showed that the all wheat varieties had safe and adequate dietary nutrients if consumed in right proportion. All the minerals had significant differences at $P < 0.05$.

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Introduction

Wheat grain is the major component of our food. The grain of wheat consists of different nutrients. Cereal products are important part of food, which include daily energy consumption worldwide. Talking about breads, bread wheat (*Triticum aestivum* L.) comes on top of list owing to detail its grain hold nutrients with chemical and physical characters (Anjum *et al.,* 1998).

The most widely grown is common wheat *(T.aestivum),* also known as bread wheat. Wheat is broadly cultivated and staple food in world wide (Zohary *et. al.*,2000;Brenchleye *et.al.,* 2012).Wheat is a cereal grain it belongs to the genus *Tritium*. It was measured as the 3rd greatest rich cereal plant after maize and rice in 2010.

Pakistan occupies a most significant position in wheat production. It is a vital primary food, used up 65%by human, 8% as seeds, 21%by animals and 6% used in productions. It is cultivated in all provinces of Pakistan (Noorka *et. al.*, 2009; Khan *et. al.*, 2009).Wheat is commonly grown on more land area than any other food crop (220.4 million Hectares 2014). Wheat world trade is greater than other combined crops (Curtis *et.al;* 2002).

The Significant part of food is cereal products including more than half of the daily energy consumption worldwide, amongst entirely cereal wheat*(Tritium aestivum* L.*)* take the 1st location due to the fact its grain hold protein with exclusive physical and chemical character(Anjum *et al.,* 1998). Wheat *(Triticum aestivum* L.) grain and its products are one of the most important components of our daily routine diet.

It is consumed directly by humans and is number one food grain. It is an essential diet for the populations of Pakistan and donates more than 60 % of the total protein and calories supplies in the everyday food.

Potassium is one of the macro element which are taken up by plants in large amounts. Its plays an important and significant roles in transportation of nutrients, water, stimulation of early growth, nitrogen utilization and in insect disease resistance (Lakudzala, 2013). Potassium is also important in the transportation of prepared food from the leaves to the rest of the plant parts strengthens the stem, roots, branches of plants, reduce lodging and quality of seeds and fruits (Imran *et al.,* 2011). Research findings in Iran, India and Bangladesh indicated that potassium fertilizer increased grain and straw yield of wheat at various rates (Astatke *et al.,* 2004).

Lithium is found in variable amounts in foods. Primary food sources of lithium are grains including wheat and vegetables which may contribute from 66% to more than 90% of the total lithium intake.

In some areas the drinking water also provides significant amount of the lithium. Grains and vegetables may be expected to provide more lithium than diets rich in animal proteins. (Dawson, 1991). Lithium (Li) is a naturally occurring element however it is one of the non-essential metals for life.

Lithium stimulates or reduced plant growth depending on its concentration. Lithium might be a serious hazardous pollutant for soil and environment in future. The intake of lithium by plant from the soil is low so the concentration of lithium in wheat grains is less as compared to other elements (Shahzad *et al.,* 2016).

In Pakistan, wheat is cultivated in almost all regions of the country and it contributes 14.4% to the value added in agriculture and 3.0 % to Gross domestic product contributing in the economy of Pakistan.

Wheat is mostly grown on irrigated land, with rain-fed wheat accounting for less than one-fifth of total production. As a result, wheat production is less variable in Pakistan than in the rest of Central Asia.

Wheat is very vital staple food of around two billion people about 36% of the world population (Shuaib *et al.,* 2007).

The accounting countries for the production of wheat in the world are Turkey, Russia, Pakistan, Ukraine and the US.

It produces over 80% of wheat in the world. The 8th largest wheat producer country in the world is Pakistan. Pakistan contributing about 3.17% of the world wheat production from 3.72% of the wheat growing area. The important food grain is wheat and takes a vital situation in agriculture and its budget (Shuaib *et al.*, 2007).

Minerals constitute between 1 and 3 percent of the weight of a cereal grain and concentrate more in the external areas of the wheat grain. (Ouaglia *et al.,* 1991).From a toxicological and nutritional point of view, their presence is very important. The metallic content in wheat is very variable and will depend on the variety, the fertilization that has been used, the type of land where it has been cultivated and the weather (Ekholm *et al.,* 2007).

This study was conducted to estimate quantity of calcium (Ca), Sodium (Na), Lithium(Li) and potassium (K) in different varieties of wheat grown in Balochistan and to compare the investigated Calcium(Ca), Sodium(Na), Lithium (Li) and Potassuim (K) contents in different types of local wheat varieties of Balochistan in order to explore the best nutritional varieties and by comparing the different varieties of wheat and checking the level of nutrients in the varieties we are able to know that which type of variety of wheat is more beneficial for human health.

Material and methods

The people generally eat bread which is made up of wheat at every meal and wheat provides most of the calories in their diet. Wheat is the staple food of Pakistan. Different varieties of wheat grown in Balochistan are rich in nutrients. The local names of these varieties are after the name of popular persons and different areas of Balochistan. Identified and popular 20 indigenous wheat varieties grown all over Balochistan were collected from Balochistan

Agriculture Research Centre Quetta. These 20 varieties; Abdul Sattar, AZRC-1, AZRI-1, Cham-6, Uqab, Glaxi 013, L3, Pir Saqib, Raskoh-05, Shahkar, Sariab -92, Sehar, Shalkot, TD-1, Taijban, Umeed, Ujala 2015, Zarlashta, Zarghoon -79 and Zardana were analyzed.

These samples were collected in plastic polystyrene small bags and washed and then dried in oven. For Quantitative analysis these grains will be grinded to form flour by using electrical grinder. For the preparation of sample in a digestion tube, 0.05 g of wheat sample were taken in a Volumetric Flask and 1 ml concentrated H_2SO_4 were added.

The sample were kept overnight and then digested for 30 min at 300 °C. After digestion 1 ml of H_2O_2 (hydrogen peroxide) were added for transparency of the material. Then 11 ml D.I. water was added in the extract. This extract were used for calcium, sodium, lithium and potassium analysis for grain sample of wheat by using Flame photometer. By observing validation parameters, method was found to be specific, accurate, precise, repeatable and reproducible. This method is simple in calculation, hence can be employed for routine analysis of these metals in various marketed formulation of wheat.

Results and discussion

Statistical analysis

In the present study, four macro elements (K, Na, Li, & Ca) were analyzed in the wheat samples collected randomly from Balochistan Agriculture Research Centre Quetta city. Twenty different samples of wheat i.e. Abdul Sattar, AZRC-1, AZRI-1, Cham-6, Uqab, Glaxi 013, L3, Pir Saqib, Raskoh-05, Shahkar, Sariab -92, Sehar, Shalkot, TD-1, Taijban, Umeed, Ujala 2015, Zarlashta, Zarghoon -79, Zardana were examined for different elements i.e. sodium, calcium, potassium and lithium. Three replicates of each variety was analyzed and the mean concentrations of them with standard errors have been presented in Table 1.

The concentration of all twenty samples were recorded and plotted as graphs.

Table 1. K, Na, Ca and Li concentration in wheat varieties of Balochistan.

S	Wheat	Potassium	Sodium	Calcium	Lithium
No	Varieties	(ppm)	(ppm)	(ppm)	(ppm)
1	Pir-saqib	3.10 ± 0.06	2.50 ± 0.04	1.50 ± 0.06	0.08 ± 0.01
2	L3	3.10 ± 0.02	1.90 ± 0.01	1.80 ± 0.04	0.04 ± 0.04
3	Raskoh	3.40 ± 0.04	2.10 ± 0.02	2.20 ± 0.01	0.01 ± 0.03
4	Sariab	3.30 ± 0.01	2.30 ± 0.05	2.40 ± 0.04	0.11 ± 0.01
5	Shahkar	3.10 ± 0.03	3.10 ± 0.04	3.00 ± 0.01	0.02 ± 0.05
6	Taijban	2.80 ± 0.01	4.20 ± 0.01	1.40 ± 0.03	0.09 ± 0.07
7	Umeed	3.40 ± 0.07	3.00 ± 0.03	2.90 ± 0.02	0.01 ± 0.02
8	Zardana	2.50 ± 0.04	4.10 ± 0.07	3.40 ± 0.01	0.13 ± 0.01
9	Zarghoon	2.90 ± 0.01	3.80 ± 0.05	3.80 ± 0.05	0.19 ± 0.03
10	Zarlashta	3.00 ± 0.03	3.90 ± 0.01	3.90 ± 0.08	0.25 ± 0.06
11	Ujala-2015	3.30 ± 0.05	3.20 ± 0.05	2.10 ± 0.01	0.01 ± 0.01
12	Sehar	3.00 ± 0.01	2.10 ± 0.06	3.10 ± 0.03	0.02 ± 0.04
13	Abdul Sattar	2.70 ± 0.03	2.40 ± 0.01	2.00 ± 0.05	0.10 ± 0.03
14	TD-1	2.60 ± 0.05	2.30 ± 0.03	2.30 ± 0.01	0.21 ± 0.01
15	Cham-6	3.00 ± 0.01	1.80 ± 0.05	2.40 ± 0.06	0.01 ± 0.08
16	AZRI-1	3.50 ± 0.05	3.90 ± 0.01	3.10 ± 0.07	0.02 ± 0.05
17	Shalkot	3.00 ± 0.03	2.70 ± 0.05	1.20 ± 0.09	0.04 ± 0.01
18	AZRC-1	3.30± 0.04	4.10 ± 0.05	1.00 ± 0.01	0.10 ± 0.04
19	Uqab	2.70 ± 0.01	3.10 ± 0.04	2.10 ± 0.06	0.07 ± 0.03
20	Glaxi 013	2.80 ± 0.03	2.30 ± 0.01	2.20 ± 0.05	0.05 ± 0.01

The comparison of each of twenty samples in all different samples was plotted with reference to concentration of standards. Statistical analysis like standard deviation, standard error, minimum, maximum P-value and mean have been presented in Table 2.

Table 2. Statistical analysis of mineral contents in wheat varieties.

Minerals	Minimum	Maximum	Mean	Std. Error	Std. Deviation	P Value
K	2.50	3.50	3.025	0.064	0.285	0.000
Na	1.80	4.20	2.940	0.182	0.813	0.000
Ca	1.00	3.90	2.390	0.184	0.821	0.000
Li	0.01	0.25	0.078	0.016	0.072	0.000

It has been reported that by increasing the potassium level the fertile tillers m^{-2}, 1000 grain weight, no of grains spike and grain yield were significantly increased (Tahir *et.al.,* 2008). The varieties Raskoh and Umeed have been found positive in severe cold and drought conditions and it is recommended to grow in cold and drought regions of Balochistan. Fig. 1 shows that the highest value of concentration was recorded in Umeed, Raskoh, Sariab-92, Ujala and AZRC-1 the lowest was recorded in Zardana. Varieties Umeed and Raskoh showed highest concentration of potassium (Fig. 1). The highest content of potassium (3.4 ppm / 0.05 g) was exposed by the sample Raskoh and Umeed and the least concentration of potassium (2.5 ppm / 0.05 g) was exposed by Zardana. The other wheat varieties similarly exposed a noticeable change in their potassium concentration as expressed in Table 1.
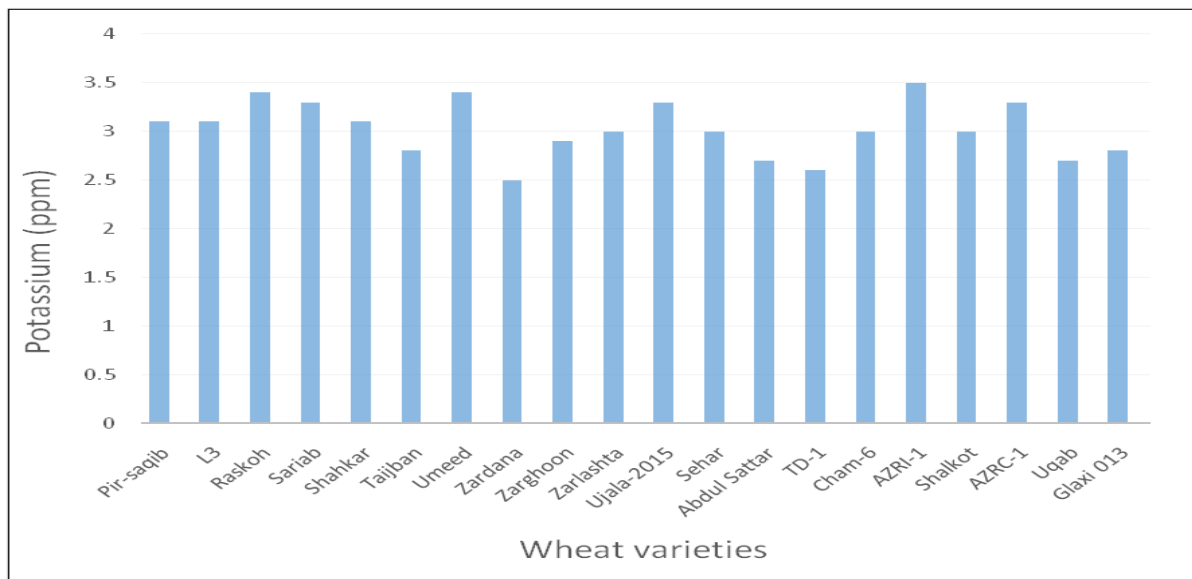
Fig. 1. Potassium concentration of different varieties of wheat grown in Balochistan.

Temperature is identified to remain a significant influence among the different environmental factors, which takes part in controlling the germination and yield of wheat. The germination of Wheat needs temperature above 3 °C whereas its formation needs 25-33 °C. Higher temperature is necessary for maturation of grain about few weeks. The variety Taijban possesses desirable quality characteristics such as better chapatti quality, potassium, sodium content and higher harvest index.
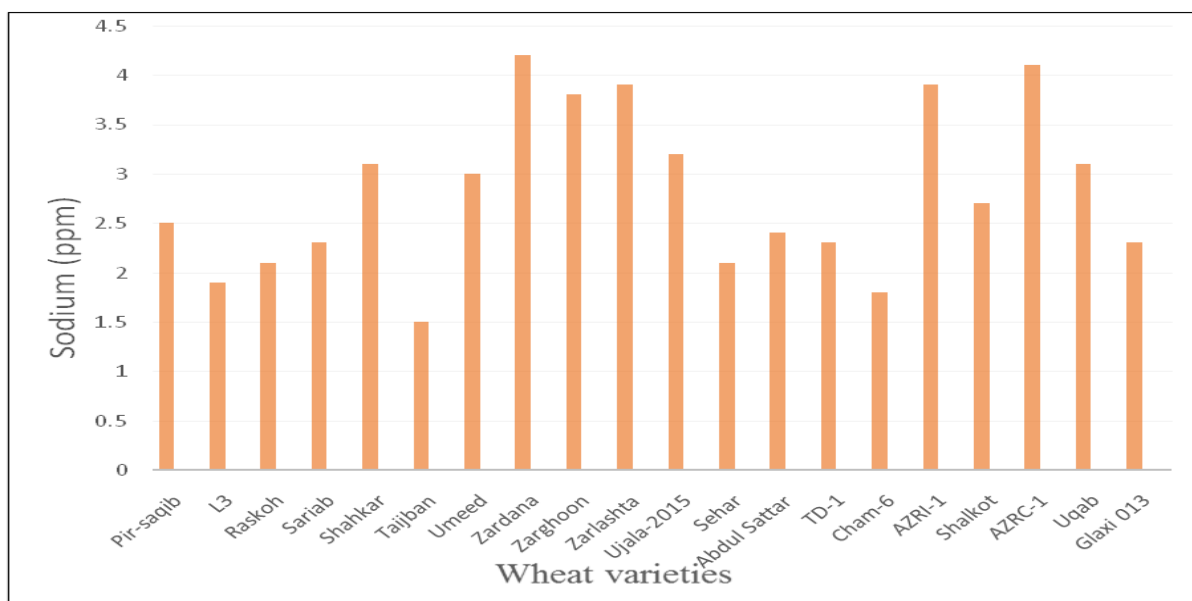

Fig. 2. Sodium concentration of different varieties of wheat grown in Balochistan.

The variety Taijban showed high acceptability among the farmers of Balochistan and already available in rain fed areas of Balochistan with significant improvement in farmers yield (Khan *et.al.,* 2013).

Figure 2 shows that the highest sodium concentration was found in the sample Taijban, Zardana and AZRC-1 whereas, the least concentration was recorded in Cham-6. The highest concentration of Sodium (4.2 ppm / 0.05 g) was shown by the sample Taijban and the least concentration of sodium (1.8 ppm / 0.05 g) was shown by Cham-6. The other samples similarly exposed a noticeable change in their sodium contents as exposed in Table 1.
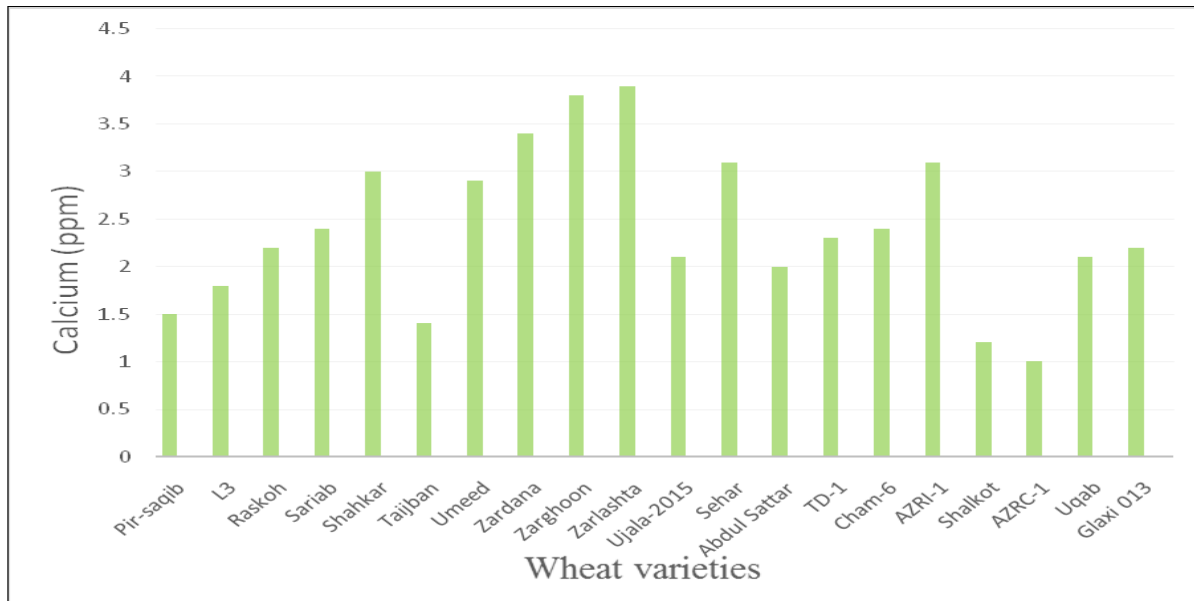
Fig. 3. Calcium concentration of different varieties of wheat grown in Balochistan.

Unfortunately, a very few research has been published with reference to nutritional analysis of wheat varieties of Balochistan. The application of calcium is multidimensional with respect to sodium ion and plant response. The response of shoot and root to calcium and sodium interaction under saline environment is that under saline conditions shoot showed positive response to sodium ion in the presence of higher calcium (Zaman *et.al.,* 2005).
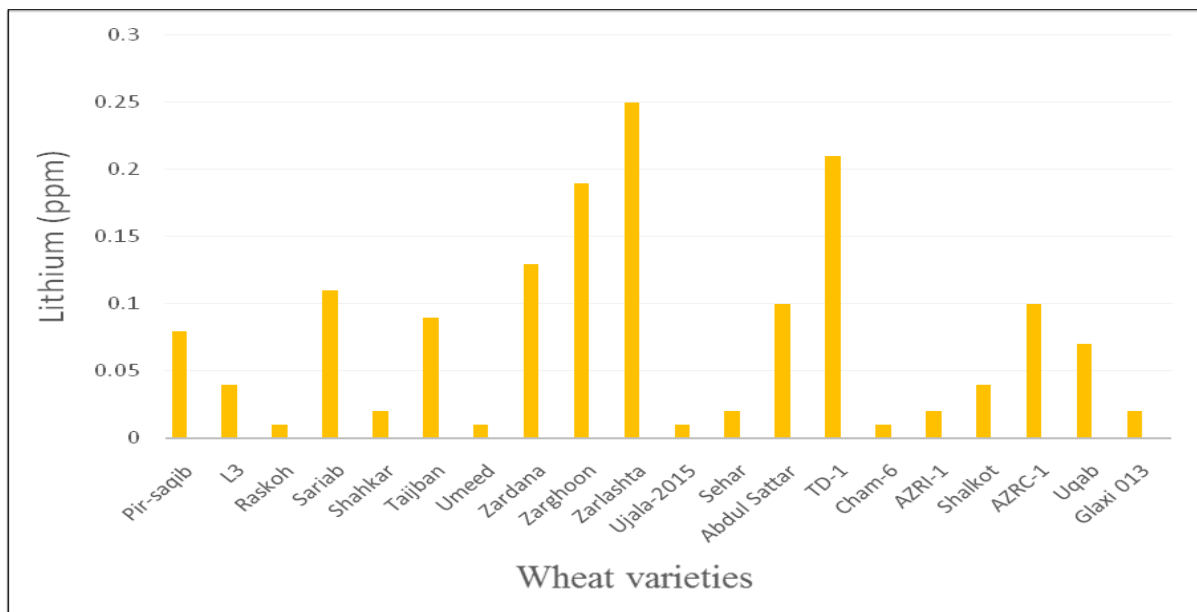

Fig. 4. Lithium concentration of different varieties of wheat grown in Balochistan.

Figure 3 shows concentration of calcium in different varieties of wheat grown in Balochistan. Highest calcium concentration was found in Zarlashta, followed by Zarghoon, Zardana and Umeed. While lowest concentration of calcium appeared in AZRC-1. Figure 4 shows concentration of lithium in different varieties of wheat grown in Balochistan. Highest lithium concentration was found in Zarlashta followed by TD-1 and Zarghoon. Whereas lower concentration of lithium was found in Raskoh, Umeed, Ujala-2015 and Cham-6. Figure 5 shows that higher concentration of Potassium, followed by

sodium and calcium occurs in wheat grains. While lithium is found in very low concentrations in wheat grains. The overall comparison showed that the wheat variety Taijban contained showed highest concentration of sodium (4.2 ppm) which is still less than the recommended value that is 4.8 ppm.
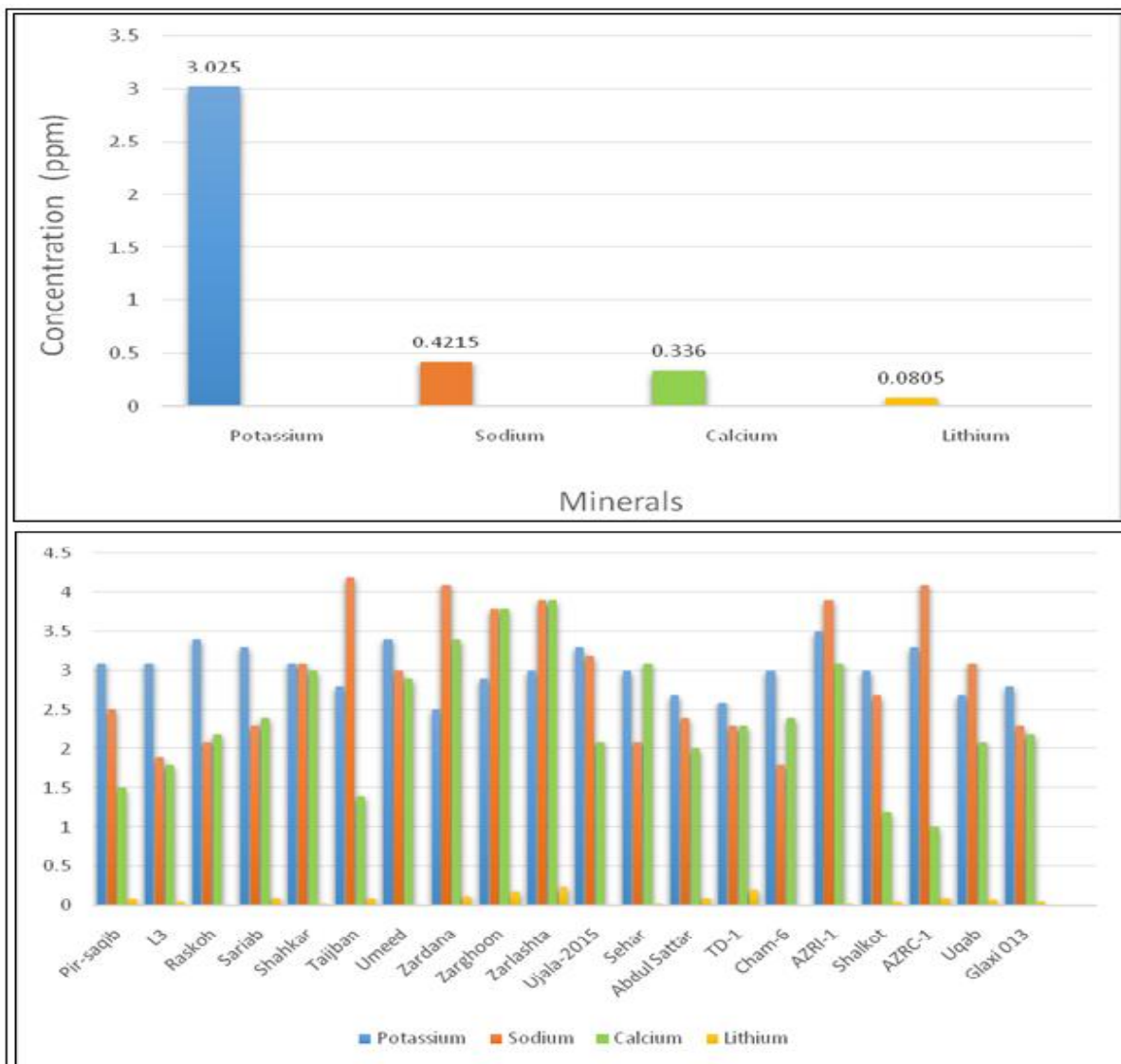

Fig. 5.

While the wheat variety Zardana and AZRC-1 contain 4.1 ppm which is under the recommended value, which is safe and beneficial for health as the content of sodium increase above the recommended value could be at a risk of cardiovascular diseases. Sodium intake by wheat in Bosnia and Herzegovina is greater than that recommended by the World Health Organization (WHO). This means that population of investigated area, which consumes whole wheat bread daily could be at a risk of cardiovascular diseases (Vukic *et.al.,* 2013). On the other hand, the comparison reveal that the variety of wheat Zarlashta,

Zarghoon and Zardana that are commonly grown in Balochistan contain adequate concentration of calcium 3.8 ppm, 3.9 ppm and 3.4 ppm, whereas the the recommended value is 7.2 ppm.

The overall comparison showed that the wheat variety Glaxi-013 contained high concentration of lithium (0.25 ppm) which is slightly higher than the recommended value that is 0.24 ppm. While the wheat variety TD-1 contain 0.21 ppm which is within the recommended range. Lithium (Li) is a naturally occurring element however it is one of the non-

essential metals for life. Lithium stimulates or reduced plant growth depending on its concentration. Lithium might be a serious hazardous pollutant for soil and environment in future (Shahzad *et.al.,* 2016). The wheat variety AZRC, Raskoh and Umeed showed higher potassium contents 3.5 ppm, 3.4 ppm, 3.4 ppm which is less than the recommended value that is 7.8 ppm so they are nutritionally best source of potassium. High content of macro elements in flour is used to yield crusty and rubbery breads and is used to produce bakery product such as cake, biscuit, puffins and pie crusts. As high potassium flour is used to make crusty and rubbery breads, therefore, Raskoh, Umeed and AZRC are ideal for making breads whereas Zardana and Taijban are perfect for baking cakes and biscuits etc.

The growth of wheat in Balochistan must be focused keeping in view the fact of increasing population and its growing demand of food. However, the promising wheat varieties that are resistant to cold and drought stress, and have more nutritional value, should be encouraged in order to get better yield and quality. This data can assist the public to purchase good excellence flour and also will raise the awareness of government, companies also public.

Conclusion

The study was conducted to explore the characteristics of wheat varieties from Balochistan. The wheat varieties of Balochistan comprised of great nutritional properties in the terms of potassium, sodium, calcium and lithium. Calcium found to be the most abundant in Zarlashta and Zarghoon while Potassium was high in Umeed and Raskoh. Sodium was found maximum in variety Taijban and Zardana and Lithium in TD-1 and Glaxi-013. All the elements detected were found adequate and below the recommended limits in different varieties of Balochistan.

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