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Variation in chemical composition and microbial contamination of Maize (*Zea mays*, L.) seedlings collected from different locations of Buner, Khyber-Pakhtunkhwa, Pakistan

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ABSTRACT

The current study was aimed to investigate the proximate composition, mineral profile, total bacterial count (TBC), and total fungal count (TFC) in the maize seedlings of Azam variety collected from 14 different locations of District Buner namely: Agarai, Ambela, Bashkata, Dagger, Elai, Jangai, Karapa, Khanano Derai, Koga, Makhrani, Nawagi, Pir-Baba, Shalbandai, and Sultanwas. The laboratory analysis of maize seedlings revealed that the highest moisture content (13.16%) was recorded in the samples from Sultanwas, crude fiber (2.55%) and crude protein (12.38%) were recorded in Agarai, while ash (3.48%), crude fat (3.46%), and NFE (79.94%) were found maximum in Koga. The lowest value of the moisture (7.66%) was found in the sample of Shalbandi, crude fiber (0.68%) was found in Bashkata, NFE (67.28%) was found in Khanano Derai, whereas ash (1.30%), crude fat (1.36%), and crude protein (7.25%) were reported in Makhrani. In the case of mineral, the maximum Na (71.55 mg 100 g^{-1}), K (415.67 mg 100 g^{-1}), and P (405.41 mg kg^{-1}) were found in Shalbandai, Daggar, and Sultanwas while the lowest was observed in Elai and Makhrani. Likewise, maximum Fe (6.85 mg 100 g^{-1}) was recorded in Koga, Zn (5.48 mg 100 g^{-1}), and Mn (2.9 mg 100 g^{-1}) in Makhrani, while Cu (2.96 mg 100 g^{-1}) and Mg (175.4 mg 100 g^{-1}) were found in Dagger. However, the minimum concentration of Zn (4.08 mg 100 g^{-1}) and Cu (0.05 mg 100 g^{-1}) were found in Agarai, Mn (0.4 mg 100 g^{-1}) in Sultanwas, Fe (0.45 mg 100 g^{-1}) in Pir-Baba and Mg (111.1 mg 100 g^{-1}) in Jangai. The TBC and TFC were highest in Elai (3.94 ×104) and Pir-Baba (4.46×103) samples while the lowest value was observed in Karapa (3.6×103) and Makhrani (1.3×102), respectively. Besides, some fungal genera were also identified in the collected samples including *Aspergillus* spp., *Fusarium* spp., *Pencillium* spp., and *Rhizopus* spp. Overall, It was concluded that geographical and environmental conditions are the major contributing factor that impacts the chemical composition and micro-flora of maize variety in different locations.

INTRODUCTION

The rapid increase in population will surely face the supreme challenge of food security and quality, especially in developing countries like Pakistan (Rahim et al., 2019). In developing countries, most of the people obtained their protein and essential nutrients from maize, about 15% to 56% of total daily calories provided by maize grain. Animal's protein is scarce and expensive; therefore, they depend on maize to meet the nutritional requirement (Prasanna et al., 2001). Maize grains are a rich wellspring of starch (72%), crude fat (17%), crude protein (10.4%), crude fiber (2.5%), oil (4.8%), vitamins and minerals (Farhad et al., 2009). The oil and protein substance is of business esteem because they are utilized as a part of nourishment producing items (Paliwal, 2000; Hobbs, 2003). It also contains vitamin B-complex, for example, B_1 (thiamine), B_2 (niacin), B_3 (riboflavin), B_5 (pantothenic corrosive) and B_6 that makes it excellent for hair, skin, absorption, heart, and cerebrum. It contains vitamin C, A and K together with a huge measure of beta-carotene and a considerable measure of selenium that enhances thyroid organ and assumes a vital part in the legitimate working of invulnerable framework.

The chemical composition of maize and its surface microbes like other crops are related to soil composition and other environmental factors including irrigation water, humidity, and temperature, etc. The major producing area of maize is District Buner in Khyber Pakhtunkhwa province of Pakistan. There is a variation in the soil profile of Buner due to its topographic features. There may be the minor and major effects of these factors on chemical composition and microbial contamination of the maize grown in different localities of District Buner. This variation may cause nutritional enrichment or deficiency in the local peoples where most of the population of District Buner depends on maize grains and flour (Saeed, 2013).

Therein, in view of public health safety and food quality, it is important to analyze the chemical composition and microbial contamination of maize grown in different geographical areas of District Buner by the local farmers and to draw the conclusions and recommendations for the variations in chemical composition and microbial contamination of maize under various environmental factors.

MATERIAL AND METHODS

Sample Collection

Composite samples of maize seedlings about 1 kg each were brought from upper areas of district Buner namely, Elai, Daggar, Karapa, Bashkata, Shalbandai, Sultanwas, Pir-baba and lower areas namely, Ambela, Nawagai, Koga, Agarai, Jangai, Makhrani, Khanano Derai. The samples were brought to the Department of Agricultural Chemistry Laboratory, The University of Agriculture Peshawar. The samples were properly cleaned and air dried, powdered by using a laboratory grinder and stored in zip-lock bags for further use. Afterward, the powder samples were analyzed for proximate composition, minerals analysis, total bacterial count (TBC) and total fungal count (TFC). The procedures are briefly described below.

Sample collection area description and Map

Buner is the district of Khyber-Pakhtunkhwa Province of Pakistan and located in between 340-11´ and 340-43´ North-Latitude and 720-13´ and 720- 45´ East-Longitude as shown in Figure 1.

Analysis of Chemical composition and microbial contamination

Proximate composition, mineral analysis, total bacterial count (TBC) and total fungal count (TFC) was determined by using the procedures of AOAC international methods (2000).

Statistical Analysis

All the experimental data were recorded as the mean of three replicates and analyzed by Completely Randomized Design (CRD) by Statistix 8.1. Similar means were separated by the least significant difference (LSD) at $p<0.05$.

RESULTS AND DISCUSSION

1. Proximate Composition

1.1. Moisture content (%)

The results of the proximate composition of maize samples collected from different locations are presented in Table 1. It was observed that among all the locations, the highest moisture content of 13.16% was recorded in the maize sample of Sultanwas followed by Pir-Baba (12.50%), whereas, the lowest value 7.66% was noted for Shalbandai. The proliferation of microbial contamination primarily depends upon its moisture content. Moisture content analyzed during the present research work ranged from 7.66% to 13.66% which are higher than the findings of Fageer and El-Tinay (2004) who examined 4.3% to 6.7% of moisture content in 12 corn genotypes. The results obtained in the current study showed that higher moisture content in maize samples may be attributed to various physiological and environmental factors such as weather, soil texture, availability of water and type of maize variety. In this regard, Ullah et al. (2010) reported a 10.90-12.20% moisture level in different varieties of corn seeds. Likewise, Trabelsi et al. (1998) reported that the moisture content in the range of 9 to 18%, which was in close consistency with the present results.

Figure 1 Desrib the sampling area of Buner District Khyber, Pakhtunkhwa, Pakistan.

1.2. Ash content (%)

Koga location has a maximum of 3.48% ash content followed by Bashkata of 3.27%, while the lowest amount of 1.30% was noted in the samples of Makhrani as shown in Table 1. The presence of mineral contents such as sodium, potassium, calcium, magnesium, aluminum, iron, copper, manganese, zinc, arsenic, iodine, fluorine and other trace elements in grains represent its ash content. These elements play a very essential role in maintaining different physiological functions in our body and also prevent some diseases like blood pressure and anemia. The values obtained during this study were in line with Saleem et al. (2008) who described ash content of 1.70% to 3.50% in different maize hybrids. Peplinski et al. (1989) reported that 1.3% and 1.5% of ash content which are supportive evidence of our findings. Maziya-Dixon et al. (2000) examined that ash was in the range of 1.4 to 3.3% which was higher than the values determined in the present study.

1.3. Fat content (%)

The crude fat content was examined highest in Koga (3.46%) and Bashkata (3.28%) whereas the lowest value (1.36%) was reported in Makhrani samples as presented in Table 1. As crude fats are the major concern of numerous diseases like cardiovascular disorder therefore it was necessary to evaluate the crude fat during the present study. The consumption of too much crude fat from the diet that extensively obtained from maize crop products may lead to chronic diseases however the recommended limited supply may lower the low-density lipoprotein blood cholesterol level which is a good sign for healthy and normal growth. It was reported that maize crude fat provides essential fatty acids in the form of linoleic acid which are mainly responsible for the proper functioning of the kidney, liver, heart, reproductive tract, digestive system and in some cases for immunity of the body. Besides this, crude fats scavenge free radicals as it contains vitamin E which exhibits antioxidant activity. Fats are not the primary source of energy in the body but it plays a vital role to maintain the proper working of different human organs in the form of phospholipids, sterols, and carotenoids (Ostlund et al., 2002). Data on crude fat content obtained during the current research work find supportive evidence from the study of Ijabadeniyi and Adebolu (2005) who reported the crude fat content of three maize varieties cultivated in Nigeria was in the range of 2.77% to 3.50%.

1.4. Crude fiber content (%)

Table 1 presented the promising values for crude fiber content examined in Agarai (2.55%) and Jangai (2.45%) while the least value (0.68%) was noted for Bashkata. Crude fiber is an essential component of the human diet. Fiber helps in mitigating stomach related issues for example constipation and hemorrhoids and additionally bringing down the possibility of colon tumors. A high amount of fiber has been found to lessen colon hazard, however inadequate and contradictory information exists for fiber's association with a tumor but the utilization of entire whole grains has been demonstrated to diminish that hazard. Fiber helps to bulk up bowel actions that facilitate peristaltic movement and even empowers the creation of gastric and bile juices. Likewise, it adds mass to excessively free stools which gradually diminish the probability of irritable bowel syndrome (IBS) and diarrhea (Bauer et al., 2011). The data obtained during the present study was supported by Ullah et al. (2010) who reported crude fiber in the range of 0.81-2.42%. Ijabadeniyi and Adebolu (2005) determined slightly higher values (2.06% to 2.88%) of crude fiber content for different maize varieties cultivated in Nigeria.

1.5. Crude protein content (%)

The results of crude protein content demonstrated that Agarai (12.38%) and Sultanwas (12.25%) location contained significant crude protein content whereas the lowest amount was noted at Makhrani (7.25%) location as reported in Table 1. Protein is an integral part of every cell find in our body for examples nails and hair are completely made of protein. Our body utilizes protein to manufacture enzymes, hormones and other body chemicals that primarily participate in various functions especially in repairing tissues. Apart from these functions, protein is also involved in the regulation of glucose in the body by a specific hormone known as insulin. Protein is an essential component of bones, muscles, ligament, skin, and blood. Protein is a remarkable component in the carrying of specific molecules. For example, hemoglobin is a protein that transports oxygen all over the body. It is in the form of antibody helps in the eradication of various chronic and drastic diseases (Soenen et al., 2008). As protein is a basic part of our diet therefore the current study was aimed to determine crude protein in maize samples taken from different localities of district Buner. Ijabadeniyi and Adebolu. (2005) reported that 7.71% to 14.60% of protein content in three maize varieties grown in Nigeria that are in line with the results of our findings. The present data were also supported by Jiang et al. (2007) who reported 7.77% to 13.84% of crude protein contents in different maize hybrids.

1.6. Nitrogen Free Extract (NFE) (%)

In the case of NFE, the maximum value 79.94% was observed in Koga sample followed by Elai 77.32% while the lowest level was observed in Khanano Derai 67.28% as shown in Table 1. The NFE represents the digestible carbohydrates. The function of carbohydrates is to supply energy as they are the body's most important supply of fuel required for the substantial activity process of the organs and brain task. In our body every cells and tissue need carbohydrates and they are also essential for intestinal fitness and waste removal. Once in the body carbohydrates are simply changed to energy (Nabb and Benton, 2006). Maize is generally recognized to be elevated in carbohydrates and a good source of calories (Nuss and Tanumihardjo, 2011). The carbohydrate content of maize samples collected in this study varied significantly (P<0.05). Ijabadeniyi and Adebolu (2005) determined slightly lower values of 65.63-70.23% carbohydrate content in different maize variety. Likewise, Ullah et al. (2010) showed percent carbohydrate in the range of 68.64-79.54% which is in close consistency with the present study.

Table 1 Proximate composition of maize samples collected from different locations of Buner

Locations	**Moisture** (%)	**Ash** (%)	**Fat** (%)	**Fiber** (%)	**Protein** (%)	**NFE** (%)
Agarai	10.33	2.17	2.17	2.55	12.38	74.87
Ambela	9.50	2.0	2.0	2.30	8.44	72.69
Bashkata	10.16	3.27	3.28	0.68	9.38	74.55
Daggar	9.16	2.37	2.30	1.57	10.93	71.38
Elai	12.33	2.22	2.20	0.73	8.50	77.32
Jangai	9.0	1.90	1.95	2.45	10.19	72.96
Karapa	9.33	2.77	2.70	1.48	11.25	72.43
Khanano Derai	8.0	2.57	2.56	2.38	11.88	67.28
Koga	8.50	3.48	3.46	1.65	8.75	79.94
Makhrani	8.50	1.30	1.36	2.13	7.25	75.18
Nawagi	8.83	1.54	1.50	2.0	10.71	73.81
Pir Baba	12.50	2.10	2.10	1.26	7.88	75.69
Shalbandai	7.66	2.68	2.66	2.43	9.69	71.52
Sultanwas	13.16	2.47	2.46	1.9	12.25	72.85

Remark: Each value is the mean of three replications (n=3) and significant at p<0.05.

2. Mineral profile of the collected maize

2.1. Sodium (Na) (mg 100 g^{-1})

Data depicted in Table 2 stated that among all locations maximum sodium content was recorded in the samples taken from Shalbandai followed by Jangai (71.12 mg 100 g^{-1}) while minimum value was noted for Elai (56.47 mg 100 g^{-1}). It was observed that there was a significant difference among all the locations at p<0.05.

Sodium is a very essential electrolyte and a crucial ion found in the extracellular liquid. One of the medical advantages of sodium is an essential part; it plays in enzyme operations and muscle constriction. It is vital for osmoregulation and liquid preservation inside the human body (Trumbo et al., 2011). Some other medical advantages include improved heart performance, nervous system, and glucose absorption. Sodium is the essential particle and electrolyte inside the body and it is required for blood regulation. Genuine debilitation of real capacity is brought about because of the nonappearance of sodium. It is a flexible component and happens in further than eighty unique structures. As an electrolyte, it directs the organic liquids and transmits electrical driving forces in the body (Bodner et al., 2009). In this regard, Hassan et al. (2009) reported 15-18 ppm of Na content in two maize varieties grown in Sudan. Feil et al. (2005) determine the mineral composition of maize grain and found sodium in the range of 3,930-3,710 ppm which also justifies the current findings.

2.2. Potassium (K) (mg 100g^{-1})

The results described in Table 2 stated that maize sample of Daggar location contained maximum (415.67 mg 100 g^{-1}) amount of potassium followed by Pir-Baba (412.67 mg 100 g^{-1}) while minimum value was observed in Makhrani (305.33 mg 100 g^{-1}. The data regarding potassium content in maize samples showed significant (P<0.05) variation. Hussaini et al. (2008) determined 3,400-3,600 ppm of potassium in maize samples of Kadawa Nigeria. Hassan et al. (2009) observed 93-108 ppm of potassium content in two maize varieties grown in Sudan which are in close agreement with the results of the present study.

Table 2 Mineral profile in (mg 100 g^{-1}) of maize samples collected from different locations of Buner

Locations	Na mg 100 g^{-1}	K mg 100 g^{-1}	P mg kg^{-1}	Mg mg 100 g^{-1}	Zn mg 100 g^{-1}	Cu mg 100 g^{-1}	Mn mg 100 g^{-1}	Fe mg 100 g^{-1}
Agarai	62.5	382.0	304.0	144.3	0.15	0.05	2.90	2.98
Ambela	68.9	324.0	231.6	143.3	1.51	0.34	2.80	5.33
Bashkata	60.7	340.6	286.1	126.0	1.98	0.58	1.34	4.50
Daggar	62.9	415.6	187.1	175.4.	3.78	2.96	1.90	0.46
Elai	56.4	374.6	110.5	131.5	3.20	1.53	0.70	5.29
Jangai	71.1	396.3	231.6	111.1	3.80	0.14	1.0	5.93
Karapa	66.5	347.6	243.2	149.8	2.33	0.28	0.60	6.56
Khanano Derai	68.3	355.6	324.3	132.5	3.15	0.55	1.60	5.92
Koga	65.9	314.0	221.1	117.4	4.08	1.44	1.50	6.85
Makhrani	59.9	305.3	81.0	141.1	5.48	1.14	2.90	0.63
Nawagi	64.2	403.6	289.5	132.1	3.50	0.22	2.0	5.38
Pir Baba	67.2	412.6	187.1	119.5	3.18	1.21	1.60	0.45
Shalbandi	71.5	362.3	162.1	137.4	1.64	0.31	0.40	5.02
Sultanwas	70.6	335.0	405.4	136.8	1.69	0.31	0.40	4.96

Remark: Each value is the mean of three replications (n=3) and significant at $p<0.05$

2.3. Phosphorous (P) (mg kg^{-1})

Results given in Table 2 reveals that Sultanwas location possess the highest phosphorus content (405.41mg kg^{-1}) followed by Khanano Derai (324.33 mg kg^{-1}) whereas the lowest amount was found in Makhrani (81.08 mg kg^{-1}). The data regarding phosphorus content in maize samples taken from different locations varied significantly at $P<0.05$.

Hassan et al. (2009) determined the mineral content of two maize varieties cultivated in Sudan and reported the level of P in the range of 410-590 ppm. This notion is in agreement with the results of the present study. Hussaini et al. (2008) determined 350-360 ppm of phosphorus in maize samples of Kadawa Nigeria which justify our findings.

2.4. Zinc (Zn) (mg 100 g^{-1})

The maximum zinc content Table 2 was recorded in the sample taken from Makhrani (5.48 mg 100 g^{-1}) location followed by Koga (4.08 mg 100 g^{-1}) whereas the minimum level was noted in the sample of Agarai (0.15 mg 100 g^{-1}).

Hassan et al. (2009) determined the mineral content of two maize varieties cultivated in Sudan and determined the level of zinc in the range of (37.05-52.4 ppm) which is in close agreement with the results of the present study. Our findings are fairly in line with those of Ullah et al. (2010) who reported that the Zn content of Azam variety of maize was 45.5 mg kg^{-1}.

2.5. Copper (Cu) (mg 100 g^{-1})

The results regarding copper content enlisted in Table 2 indicates that Daggar and Elai locations possess a maximum amount of copper content having values of 2.96 mg 100 g^{-1} and 1.53 mg 100 g^{-1} while minimum concentration was found in the sample of Agarai having the value of 0.05 mg 100 g^{-1} respectively. The data suggest that variation among all the maize samples were significant ($P<0.05$).

Feil et al. (2005) determine the mineral composition of maize grain and found sodium in the range of 2.21-2.36 ppm. These results are not in agreement with the results of the present study. Ullah et at. (2010) reported that Azam variety of maize contained 14.03 mg kg^{-1} Cu contrary to current findings.

2.6. Manganese (Mn) (mg 100 g^{-1})

The results depicted in table-2 divulged that Makhrani location has promising manganese content (2.9 mg 100 g^{-1}) followed by Ambela (2.8 mg 100 g^{-1}) while the lowest level was observed in Sultanwas (0.4 mg 100 g^{-1}). Feil et al. (2005) determine the mineral composition of maize grain and found manganese in the range of 82-137 ppm which is in close consistency with the present result. The results are fairly in line with those of Hassan et al. (2009) who analyzed the mineral content of two maize varieties cultivated in Sudan and indicated the level of manganese in the range of (410-590 ppm).

Table 3 Total bacterial and total fungal count of maize samples collected from different locations of Buner

Locations	Total bacterial count (cfu g^{-1})	Total fungal count (cfu g^{-1})
Agarai	1.8 × 104	1.36 × 103
Ambela	2.2 × 104	2.95 × 103
Bashkata	1.73× 104	3.77 × 103
Daggar	1.84 × 104	3.0 × 102
Elai	3.94 × 104	1.49 × 103
Jangai	3.85 × 104	1.75 × 103
Karapa	3.6 × 103	1.79 × 103
Khanano Derai	1.15 × 104	2.62 × 103
Koga	3.64 × 104	1.92 × 103
Makhrani	1.70 × 104	1.3 × 102
Nawagai	1.93 × 104	4.5 × 102
Pir-Baba	2.30 × 104	4.46 × 103
Shalbandi	9.2 × 103	1.90 × 103
Sultanwas	2.10 × 104	1.44× 103

2.7. Iron content (Fe) (mg 100 g^{-1})

The results presented in Table 2 indicates that Koga location contain high concentration of iron (6.85 mg 100 g^{-1}) followed by Karapa (6.56 mg 100 g^{-1}) whereas the lowest level was found in Pir Baba (0.045 mg 100 g^{-1}). Our results are fairly in line with those of Ullah et al. (2010) who reported that the Fe content of Azam maize variety was 42.5 mg kg^{-1}. Hassan et al. (2009) determined the mineral content of two maize varieties cultivated in Sudan and showed the level of Fe in the range of (38.02-56.14 ppm) which is in close consistency with the present results.

2.8. Magnesium (Mg) (mg 100 g^{-1})

The results given in Table 2 showed that Dagger location has the highest magnesium content (175.4 mg 100 g^{-1}) while Jangai has the lowest value (111.1 mg 100 g^{-1}) among all the locations. It was observed that magnesium content in maize samples taken from different locations was significant at $p<0.05$. The result showed similarity with the data investigated by Ullah et al. (2010) who reported 1,625 mg kg^{-1} of Mg content in Azam variety of maize. Hassan et al. (2009) investigated the mineral content of two maize varieties in the range of (985.2-1,125.3) ppm which are in line with the current findings.

3. Total Bacterial and Total Fungal Counts (cfu/g)

It is well known that some fungi and bacteria grow on and in corn grains and they can cause the deterioration of stored grains. Therefore, the present work was aimed to determine the total bacterial and total fungal counts. The results depicted in Table 3 revealed that the sample of Elai location has a higher bacterial population (3.94×10^4 cfu g^{-1}) followed by Jangai (3.85×10^4 cfu g^{-1}) whereas the lowest counts were observed in Karapa (3.6×10^3 cfu g^{-1}). In the case of total fungi count highest value was recorded for Pir-Baba (4.46×10^3 cfu g^{-1}) followed by Bashkata (3.77×10^3 cfu g^{-1}) whereas lowest fungal counts were observed in Makhrani (1.3×10^2 cfu g^{-1}).

After total fungal counts, all the fungal species were then screened to isolates their pure culture. For this purpose, the fungal inoculums were spread on the PDA medium and each species was identified by carefully studying of their morphological characteristics. The results depicted in Table 4 shows that grain samples were contaminated with a variety of different fungal species however the predominant species identified during the current research study include *Aspergillus spp., Fusariumspp., Penecillium spp.,* and *Rhizopus spp.* It was also observed that among all locations, *Aspergillus spp.,* was predominantly observed in Daggar (93.33%), *Fusarium spp.,* in Jangai (88.09%), *Penecillium spp.,* in Koga (54.41%) and *Rhizopus spp.,* in Karapa (33.33%). The current results find supportive evidence from the study of Nooh et al. (2014) that reported many types of fungi such as *Fusarium, Aspergillus,* and *Penicillium* in Egyptian maize and also determine their total fungal counts. Likewise, Ntuli et al.

(2013) identified microbes of the genera *Escherichia*, *Klebsiella*, *Aerobacter*, *Enterobacter*, *Salmonella*, *Bacillus*, *Aspergillus*, *Penicillium*, *Fusarium*, *Candida*, *Saccharomyces* and *Rhodotorula* in maize and wheat flours which justifies our findings. Nogaim (2012) evaluated corn grains and found total bacterial count in the range of 1.2×10^6 to 9.2×10^6 cfu, total fungi count was 5.2×10^4 to 3×10^5 cfu whereas the most dominant genera were *Aspergillus*, *Penicillium*, *Fusarium* and *Rhizopus*.

Table 4 Total fungal species isolated from maize samples collected from different locations of Buner.

Locations	Total fungal isolates	*Aspergillus spp*	*Fusarium spp*	*Penecillium spp*	*Rhizopus spp*
Agarai	10	20	70	10	0
Ambela	13	0	76.92	23.07	0
Bashkata	38	84.21	5.26	0	10.52
Daggar	17	93.33	0	6.66	0
Elai	12	16.66	58.33	8.33	16.66
Jangai	42	7.14	88.09	4.76	0
Karapa	6	33.33	16.66	16.66	33.33
Khanano Derai	8	12.5	50.0	25.0	12.5
Koga	68	4.41	39.7	54.41	1.47
Makhrani	7	28.57	42.85	28.57	0
Nawagai	17	29.41	41.17	29.41	0
Pir-Baba	91	12.08	85.71	2.19	0
Shalbandi	7	14.28	28.57	42.85	14.28
Sultanwas	14	57.14	14.28	21.42	7.14

CONCLUSION AND RECOMMENDATIONS

From the experimental findings it was concluded that geographical and environmental conditions are the major contributing factors that impact the chemical composition and micro-flora of maize variety in different locations.

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