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Studies of Millets through SEM and & EDS

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Abstract

Scanning electron microscopy and energy dispersive X-ray spectroscopy were used to conduct the essential multielement analysis and to examine the surface morphology at the nano- and microscale of 6 millets medicinal plants. To comprehend the elemental analysis of medicinal millets that were taken from the districts of Belagavi and Mysore in the regions of North and South Karnataka.

In the current study, Millets were chosen. A detailed nano-microphotograph was taken of the samples using an SEM, and an EDX/EDS analysis determined the exact weight percent of elemental concentration.

After being assessed in all of the collected MILLETS, the elemental concentrations of O, C, P, Mg, Mn, K, Cu, Fe, Hg, Zn, and Pb were discovered to be under the WHO Permissible Limit values. SEM morphology shows that the examined Millets contain fine plane irregularly shaped particles with an average diameter of 200nm–1 μm.

Keywords: Field Scanning electron microscope-energy dispersive X-ray spectroscopy method; Elements; Permissible limits; Medicinal plants; World Health Organization.

1. Introduction

The environment's natural resources, or medicinal plants, are highly valued in traditional medicine and are suggested as at-home treatments. Since ancient times, people all around the world have been aware of the traditional plant medical system. The Vedas and other scriptures contain information on the extensive and effective development of Indian traditional medicinal plants between 2500 and 500 BC, along with several indigenous medical systems including Siddha, Herbal, and Unani. In India, there are around 4 million kinds of medicinal plants; of these, barely half have been studied as potential therapeutic plants. Essential roles for trace, major, minor, and heavy elements are played by medicinal plants and by the human body to maintain healthy biological activity. Examining the type of elemental contents that medicinal plants in a given area/region have as a baseline is crucial, especially considering the World Health Organization's (WHO) permitted limitations. Additionally, the WHO and the Ministry of Health and Family Welfare's Department of AYUSH (Ayurveda, Yoga, and Naturopathy, Unani, Siddha, and Homoeopathy) concentrated on enforcing rules and raising standards in the fields of quality assurance and standard operating procedures for the manufacturing of medicinal plant drugs. In view of the aforementioned, the current study uses the SEM-EDX (Scanning Electron Microscope-Energy Dispersive X-ray Spectroscopy) method to analyze elements and conduct nano-micromorphological activity on MILLETS [Medicinal plants]. Specifically, the study looks at Pearl Millet, Finger Millet, Foxtail Millet, Kodo Millet, Proso Millet, and Little Millet, which were collected from various locations in the Belgavi and Mysore Districts of the North and South Karnataka regions. Using a non-destructive approach, the instrument model number in the current configuration is an ultra-55-SEM EDX apparatus with an Oxford 10 mm detector and a 1 nm scanning resolution for X-ray analysis and mapping.

2. Materials & Methods

Sample Collection of medicinal plants. The images of Millets Medicinal plants like Pearl Millet, Finger Millet, Foxtail Millet, Kodo Millet, Little Millet, and proso Millet collected from different places of, Belgavi & Mysore Districts of North & South Karnataka regions respectively, Fresh and mature Millets are used for analysis purposes

Study Area

In North & South Karnataka samples are collected from Belgavi & Mysore regions respectively. Many different types of ores are available; soil quality varies depending on ingredients and color, which

may affect yield. In this region, the elements that are most frequently available are C, O, Mg, P, K, Mn, Fe, Cu, Zn, Hg, and Pb East, respectively; these elements cover two districts geographically. Districts like Belgavi and Mysore Districts are included in the current study.

Sample Preparation

After being cleaned with distilled water to get rid of dirt, sand, and clay, the millet samples were left to air dry for 30 days at room temperature in an airtight laboratory. The plants' dried millets were ground into a fine powder utilizing a mixer grinder, and after that, they were sheaved through a mesh measuring 355 µm to create an airtight container. After preparing 10 mg of fine powder, elemental analysis was performed.

Data Analysis

By raster scanning any sample surface with a high-energy electron beam, the SEM produces images. The sample's atoms will react to the incident electron by emitting photons, which are then used to analyze the produced images and communicate information about the sample's composition, surface topography, and other characteristics including mechanical and electrical ones. The field emission sources have a resolution of roughly 2nm at 1 keV and roughly 1nm at 15 keV, correspondingly, with a “cold cathode field emitter cross-over diameter of 10nm. Consequently, in the field of nanomaterial science, the FESEM is a highly helpful high-resolution instrument for surface” imaging. For elements heavier than C, the method's detectable sensitivity is greater than 0.1 percent, and it is non-destructive. When a sample is exposed to an electron beam, X-rays are created, which are detected by EDS. The sample's atoms are excited by the electron beam, and this releases extra energy in the form of X-rays. The distinctive peaks that correspond to the various elements included in the sample are represented by the energy of the L or K X-rays that are released from it. As many distinct elements as there are in the sample are represented by the rise in peak x-ray energy. The peak intensity gives information regarding the proportion of the same element in the sample. EDX spectra can be gathered from a precise location since the electron beam can be accurately controlled.

3. Results And Discussion

The elements are shown in Table 1's first column and first row, respectively, while the WHO/FAO (Food and Agriculture Organization) permitted limits are shown in Table 1's last row. It was discovered that the coarse grain size of MILLETS ranged from 200 nm to 1 µm and that nearly all of them had the round surface shape characteristic of the Millet family. Table 1, it is shows that Mg, P, K, Mn, Fe, Cu, and Zn then seem to have greater concentration in all MILLETS, the crucial element, like Phosphorus (P) which is in a better range & plays an important role. The body requires the mineral phosphorus to create proteins that help cells and tissues grow and repair, as well as to form bones and teeth. Additionally, phosphorus is involved in the body's metabolism of sugars and carbohydrates. Moreover, it supports physiological processes using magnesium (Mg), which is a complement to calcium and a crucial component in regulating and maintaining blood insulin levels. The other crucial element is potassium (K), which significantly reduces the risk of having a heart attack. In a similar vein, the other elements—iron, copper, and zinc—are the extra components that support the production of hemoglobin in the blood. The current study concentrated on hazardous elements including mercury (Hg) and lead (Pb) that are found in mercury, however, the availability of these elements was determined to be far lower than the WHO's permitted limits. Health effects of **MERCURY** exposure. Different mercury compounds can cause ingestion, skin contact, inhalation, or ingestion that results in **NEUROLOGICAL AND BEHAVIORAL DISORDERS.** Tremors, migraines, sleeplessness, neuromuscular effects, memory loss, and cognitive and motor dysfunction are some of the symptoms. Led exposure can harm the **kidneys, and the brain, and cause anemia and weakness**. Excessive exposure to lead can be fatal. Lead exposure during pregnancy puts unborn children in danger as well since it can cross the placental barrier.

Specifications of Various Millets & Medicinal Use

SLNO		LOCAL NAME	CODING	PART	MEDICINAL USE
1	PENNISETUM GLAUCUM	PEARL		GRAIN	advantageous for heart health helpful in the treatment of stomach ulcers aids in the formation and repair of bones lowers the risk of cancer Beneficial for diabetes, Beneficial in Preventing Gall stones, Anti-allergic properties
2	PANICUM SUMATRENSE	LITTLE		GRAIN	aids in controlling blood sugar levels when regularly ingested. It revealed increased HDL cholesterol, decreased LDL/VLDL cholesterol, and decreased triglyceride levels. Reduces risk of Heart Attack, Rich in Anti-oxidants.
3	ELEUSINE COROCANA	FINGER		GRAIN	This helps in controlling blood sugar, control cholesterol levels by eliminating excess fat from the Liver An excellent natural source of iron is ragi. It is helpful for depression, anxiety, and sleeplessness (sleepless nights). Ragi helps with migraines as well. Additionally advised for breastfeeding mothers is ragi.
4	SETARIA ITALIICA	FOXTAIL		GRAIN	Because foxtail millets are high in calcium and iron, they help to keep muscles and bones healthy. Because foxtail millet has a lot of vitamin B1, it may help prevent many neurological conditions. Low in carbohydrates, high in protein, and free of gluten is foxtail millet.
5	PANICUM MILIACEUM	PROSO		GRAIN	Magnesium is abundant in proso millet, which lowers BP and lowers heart attack risks, strokes, and atherosclerosis. Millet's high fiber content contributes to cholesterol reduction.
6	PASPASUM SCROBICULATUM	KODO		GRAIN	Strong antioxidants may be found in remarkable amounts in kodo millets. The phenolic compounds in this tiny millet help lower blood pressure, prevent many chronic illnesses, and lower LDL or bad cholesterol, which is good for the heart. These antioxidants also work against free radicals, which harm cells and tissues. By stopping radicals from damaging cells and tissues, these antioxidants help prevent malignancies of all kinds.

Information of Elemental Concentration in Millets Selected From Mysore & Belgavi [Karnataka]

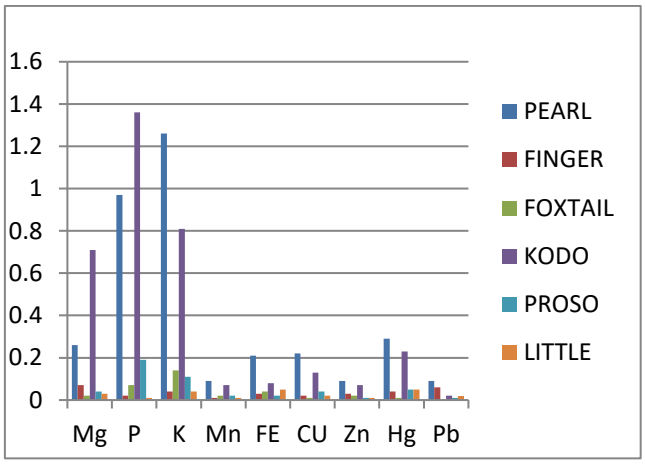
Table 1 Mysore

LOCATION	MILLETS	Mg	P	K	Mn	Fe	Cu	Zn	Hg	Pb
MYSORE	PEARL MILLET	0.26	0.97	1.26	0.09	0.21	0.22	0.09	0.29	0.09
	FINGER MILLET	0.07	0.02	0.04	0.01	0.03	0.02	0.03	0.04	0.06
	FOXTAIL MILLET	0.02	0.07	0.14	0.02	0.04	0.01	0.02	0.01	0.00
	KODO MILLET	0.71	1.36	0.81	0.07	0.08	0.13	0.07	0.23	0.02
	PROSO MILLET	0.04	0.19	0.11	0.02	0.02	0.04	0.01	0.05	0.01
	LITTLE MILLET	0.03	0.01	0.04	0.01	0.05	0.02	0.01	0.05	0.019

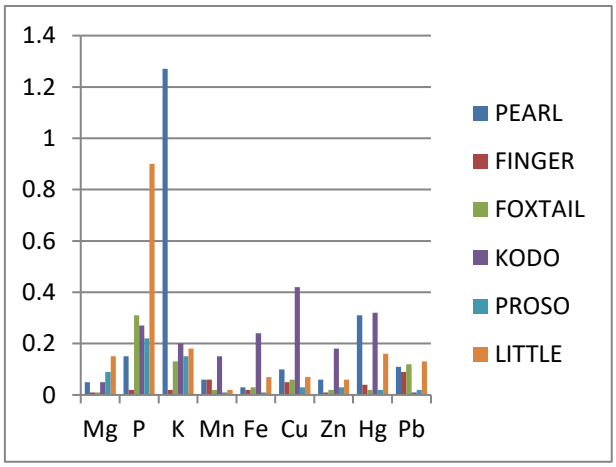
TABLE 2 BELGAVI

LOCATION	MILLETS	Mg	P	K	Mn	Fe	Cu	Zn	Hg	Pb
BELAGAVI	PEARL MILLET	0.05	0.15	1.27	0.06	0.03	0.10	0.06	0.31	0.11
	FINGER MILLET	0.01	0.02	0.02	0.06	0.02	0.05	0.01	0.04	0.09
	FOXTAIL MILLET	0.01	0.31	0.13	0.02	0.03	0.06	0.02	0.02	0.12
	KODO MILLET	0.05	0.27	0.20	0.15	0.24	0.42	0.18	0.32	0.01
	PROSO MILLET	0.09	0.22	0.15	0.01	0.01	0.03	0.03	0.02	0.02
	LITTLE MILLET	0.15	0.90	0.18	0.02	0.07	0.07	0.06	0.16	0.13

Graphical Representation of Elemental Composition of Elements in Millets of Mysore & Belgavi District



GRAPH 1



GRAPH 2

4. Conclusion

According to the current results, MILLETS demonstrates that, in comparison to the typical grains in two districts, samples of pearl millet, finger millet, foxtail millet, kodo millet, proso millet, and little millet collected from various locations have

higher concentrations of Mg, P, K, Mn, Fe, Cu, and Zn elements. Additionally, the SEM study reveals that the plant's surface shape is semicrystalline and amorphous, with a grain size of 200 nm. According to the investigation, the surface morphology with factors related to grain size is crucial for treating illnesses as soon as possible. The elemental concentrations of P, Mg, Mn, K, Cu, Fe, Hg, Zn, and Pb that were examined are lower than the WHO/FAO permitted limits. The current work data details The maximum concentration of magnesium (Mg) is shown in Graph 1. Mg, along with calcium, regulates and maintains blood insulin levels. highest phosphorus (P) concentration, which is within a better range and has a significant role The body requires the mineral phosphorus to create proteins that help cells and tissues grow and heal, as well as to form bones and teeth. Additionally, phosphorus is involved in the body's metabolism of sugars and carbs. The graph displaying the highest concentration of potassium (K) significantly reduces the likelihood of experiencing a heart attack.

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