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Elemental Analysis of Olax scanden by EDX Method

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Abstract

Olax scandens leaves are consumed as vegetables in some parts of Myanmar. The elemental concentration of Olax scanden leaves (Lelu) were carried out by using the Energy Dispersive X-ray Fluorescence detection method. The results showed that the most concentrated element in the Olax scanden leaves were carbon, the second most concentrated one is oxygen and other elements such as, Magnesium, Aluminium, Silicon,Potassium,Sulphur,Chlorine,Phosphorus, Calcium and Iron were also observed in the Olax scanden leaves. Leaves of Olax scanden is used for cure of liver diceases and traditional medicines for the treatment of several other diseases on the human body.

Keywords: Olax scanden,Trace elements,SEM-EDX,Medicinal plants.

1. Introduction

Olax scanden is a shrub or small tree found throughout tropical region in Myanmar. Fruits and leaves of this plant are used for medicinal and food purpose. Traditionally, leaves of Olax scandens are used as vegetables in constipation. Olax scandens, frequently available ethno medicinal plant, commonly known as "Badru" used for food and various medicinal purposes.

SEM-EDX among the various analytical techniques used for the elemental analysis, is highly quantified for the identification and quantification of different elements in medicinal plants for various biological and environmental importance. Elemental research has definitely been part of this explosion of scientific knowledge. Impressive developments in the field of mineral elements have taken place in the chemical, biochemical and immunological areas of research. Deficiency of tract elements in human subjects can occur under the most practical dietary conditions and in many diseased statuses. In recent years, scientist and nationalists have started believing in the therapeutic role of metals in human health. Trace elements play both curative and preventive role in combating diseases. There is a vart scope to exploit the preventive medicinal aspects of various trace elements.

Medicinal plants play of the most important role in traditional medicine. Mineral elements through usually form a small portion of total combination of most plant materials and total body weight, it was nevertheless of treat physiological importance particularly in body metabolism.

The Olax scandens leaves are the most beneficial parts of this tree. The fresh Olax scanden leaves are eaten as vegetables the dried leaves are drunk daily and mixed with other herbal decoctions. Olax scanden is one of the most commonly used medicinal plants. In this study, the Olax scanden leaves were collected from Hlegu Township, near the Yangon region, Yangon Division, in Myanmar. The fresh leaves of Olax scandens were washed, air-dried at room temperature about one month and then

pulverized, crushed into fine powder, grounded with agate motor and pestle traditional used.

The measurement of element concentration was determined by X-ray fluorescence detection method. In this finding, the present of different major minerals such as C, O, Mg, Al, Si, P, S, Cl, K, Ca and Fe suggest that regular consumption of the Olax scandens can help and provide essential nutrients and elements to human body.

2. Sample collection and preparation

Fresh leaves of Olax scandens were collected from Hlegu Township, near Yangon, in Myanmar. The Olax scandens leaves were separated from the stalk, washed and air dried at room temperature. After one month later, the dried leaves were crushed and ground into fine powder by using grinding machine. Olax scandens are shown in Figure 1.

Figure 1.Fresh leaves of Olax scandens

Firstly the sample preparation is very important for grinding machine process in order to get fine powder. In the EDX analysis, the sample should the ensuring the homogeneous dense materials to obtain fine results in the X-rays emission spectroscopy. The element concentration in the Olax scandens leaves were observed on high performance fundamental parameter (FP) method over Zeiss EVO 60 SEM-EDX system.

3. Materials and methods

The Fluorescent X-ray Spectroscopy is used for a wide range of applications to analysis samples in various forms, from solids to powders to liquids. X-ray is one kind of electromagnetic waves that is not easily absorbed by light elements but is easily absorbed by heavy elements. When the material is struck by electrons or X-ray, it generates new X-rays, called Fluorescent X-rays. An X-ray collides with an atom and an inner shell electron close to the nucleus of the atoms is knocked out., leaving a hold. An outer shell electron drops into this hole and a high-energy orbit (outer shell) to a low-energy orbit (inner shell) radiates the energy difference as an electromagnetic wave, the fluorescent X-ray generated.

The fluorescent X-ray have a specific energy (wavelength) depending on the element struck, elements can be identified by measuring this energy (wavelength). Since the intensity of the fluorescent X-ray is proportional to the quantity of each element can be estimated by measuring this intensity. This method of analysis using fluorescent X-ray is called fluorescent analysis (XRF). The fluorescent X-ray generated from the sample enter the semiconductor sensor at the same time. Then, calculation for each element (each energy) is performed through electric signal processing and the fluorescent X-ray spectrum is obtained with multiple elements can be analysed at the same time.

The fundamental parameter (FP) is the target can be used in order to increase the efficiency of generation of fluorescent X-ray of specific element. The K-rays from the rhodium can generate fluorescent X-ray from heavy elements efficiently and the L-rays from the rhodium can generate fluorescent X-ray from light elements efficiently. The SSD electrically processes extracts the sample as signals. The rhodium (Rh) is the target can be used in order to increase the efficiency of generation of fluorescent X-ray of specific element. The K-rays from the rhodium can generate fluorescent X-ray from heavy elements efficiently and the L-rays from the

rhodium can generate fluorescent X-ray from light elements efficiently.

The SSD electrically processes extracts the sample as signals. The SSD is connected to an amplifier the extracts signals and a Pulse High Analyzer (PHA) that sorts and classifies the extracted signals input from the SSD into fluorescent X-ray signals for each energy. The signals from fluorescent X-ray signals for each energy. The signals from the amplifier are successively sent to PHA and PHA classifies information that shows which type of elements are represented.

Scanning Electron Microscopy (SEM) provides a high resolution, high magnification image of a sample material by emitting a finely focused beam of electrons onto a sample. This beam interacts with the molecular composition of the sample. These interactions produce a series of measurable electron energies that are analyzed by the scanning electron microscope to create a three dimensional image.

The beam of electrons emitted on the sample also produces x-rays. The energy dispersive x-ray (EDX) instrument collects the x-rays and converts them into useful information. Each element has a set of characteristic x-ray lines. The energy dispersive x-ray technique is utilized to identify the element and measure and the composition of the sample material. The output from the EDX analysis is a spectrum. The EDX spectrum is a plot of how frequently an x-ray is received for each energy level. An EDX spectrum normally displays peaks corresponding to the energy levels (when the most x-rays were received). These peaks are generally unique to an element. Higher peaks in the spectrum indicates higher concentrations in that elements. Overlapping peaks from mixtures are deconvolved using special computer software.

Energy dispersive x-ray systems are often attachments to scanning electron microscopy instruments. Typically scanning electron microscopy provides the visual analysis and energy dispersive x-ray provides the elemental analysis. Scanning electron microscopy with energy dispersive x-ray is a powerful tool to classify and discriminate materials because they can simultaneously examine the morphology and the elemental composition of objects. Some of the typical applications of SEM-EDX are identification and classification of different materials structures, examination of surface morphology, particle contamination identification, structural analysis, forensic examinations, identification of corrosion and oxidation problems, product and process failure. Process diagram is shown in Figure 2.

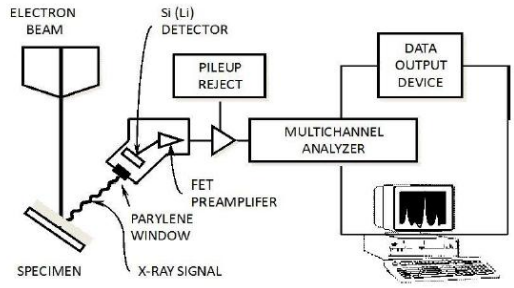

Figure 2.Process diagram for SEM-EDX

Specification of Zeiss EVO60 SEM-EDX

(1) Zeiss EVO60 Scanning Electron Microscope with Oxford EDS Detector. The microscope works with tungsten filament and maximum acceleration voltage of 30 KV.

(2) Sputter Coater of Gold-Palladium target,

Model: POLARON – SC 7620, Carbon Accessory, Model-CA76 Facilities:

(1) Secondary Electron Detector (SE)

(2) Back Scattered Electron Detector (BED)

(3) Energy Dispersive X-ray Spectroscopy (EDS): for

- Qualitative Microanalysis,
- Quantitative Microanalysis,
- X-ray Area Mapping,
- Line Scanning

(4) Wavelength Dispersive X-ray Spectroscopy (WDS): for

- Qualitative Microanalysis,
- Quantitative Microanalysis,

(5) Electron Backscattered Diffraction (EBSD)

(6) Variable Pressure Secondary Electron (VPSE) mode. Figure 3 is depicted EVO60.

Figure 3. Zeiss EVO60 SEM-EDX

4. Results and discussion

In the EDX analysis, the result showed that the largest concentrated element in the Olax scanden leaf was Carbon. The second most concentrated one was Oxygen and other elements such as Magnesium, Aluminum, Silicon, Phosphorus, Sulfur, Chlorine, Potassium, Calcium and Iron were also containing the Olax scanden leaves. The concentration of elements expressed in Table 1. and Figure 4.

Table1.Elemental Concentration of Olax scanden leaves

Element	Weight%
C	52.02
O	45.40
Mg	0.09
Al	0.07
Si	0.29
P	0.06
S	0.10
Cl	0.11
K	1.09
Ca	0.65
Fe	0.12
Totals	100.00

4.1 Compositional element for life extension

The results depicted that the most concentrated element in Olax scandens leaves was Carbon. Carbon is very important to life because it bonds in so many different ways to from compounds in

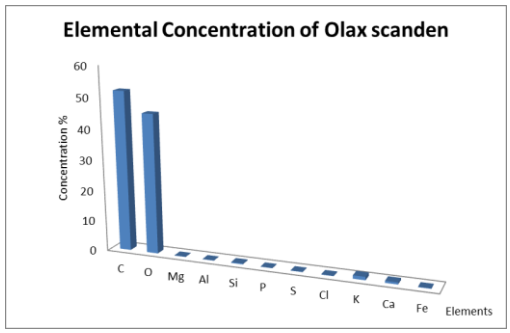

Figure 4.Element concentration of Olax scanden

the body needs every day. Energy living organism contains carbon in some way or another. Carbon is mixed with carbon dioxide while in the body. But lack of it or to much can lead to health problems. Almost 99% of the mass of the human body is made up of six elements. There are carbon, oxygen, hydrogen, nitrogen, calcium and phosphorus. Only about 0.85% is composed of another five elements such as potassium, sulfur, sodium, chlorine, and magnesium. There is nothing like health benefit with carbon but without carbon the body won't exist. Oxygen is important to every cell in the body. Without it, cells can't make energy, and their metabolism is less effective. Oxygen is a colorless, odorless gas. It is a chemical element. Oxygen is the most abundant element in the universe and makes up over 20% of the earth's atmosphere. Oxygen is highly reactive, and so it has to be carefully handled to avoid tissue damage, especially from the more reactive oxygen species that sometimes results from metabolic processes.

Getting enough magnesium is vital. Many foods contain it, and many high-quality supplements are available. Magnesium supplements may improve insulin resistance in people with metabolic syndrome and type 2 diabetes. Magnesium helps lower blood pressure in people with elevated levels. Magnesium is a mineral that supports hundreds of chemical

reactions in the body. However, many people get less than daily need.

A small amount of aluminum will enter the body through lungs. A very small amount of aluminum in food or water will enter the body through the digestive tract. An extremely small amount of the aluminum found in antacids will be absorbed. Silicon is mineral and there are many health benefits associated with it. Silicon is used for weak bones, heart disease and stroke, Alzheimer's disease, hair loss, and improving hair and nail quality. This element also plays a vital role in the prevention of atherosclerosis, insomnia, and tuberculosis, and aluminum toxicity.

Phosphorus plays on important role in ensuring everyone have strong bones and teeth. It also helps the kidneys filter out waste and works with the body in storing energy and metabolizing nutrients for energy.

Sulfur is the most abundant mineral in the body, about half being concentrated in the muscles, skin and bones, and is essential for life. Sulfur makes up vital amino acids used to create protein for cells, tissues, hormones, enzymes, and antibodies. The body uses up its store daily so it must be continually replenished for optimal health and nutrition. Chlorine cam enter the body through skin absorption or through the eyes, nose, and ears. The chemical helps keep the body's safe from an otherwise bacteria – filled soup of pool water and pee.

Potassium is mineral in the human body and is a powerful element in improving health. It contains the components for maintaining a high level of well-being and an improved lifestyle.

The health benefits of potassium include relief from stoke, high blood pressure, heart and kidney disorders, and anxiety and stress. It helps enhance muscle strength, metabolism, water balance, electrolytic functions, and the nervous system.

Calcium is a key nutrient in the human body. The primary emphasis on calcium consumption during its initial scientific discovery was focused on early human life primarily during growth periods if infancy and childhood. The interest on calcium requirements during the last decade has been expanded to apply to the entire life cycle from birth through elder years. Many commercial food and nutrition supplement products contain calcium fortification today in response to a wider audience.

Iron is one of the most vital minerals. While all human cells contain, it is mostly found in red blood cells. The health benefits of managing iron levels include eliminating fatigue and many of its sources. Iron also plays a vital role in immune system function, treating anemia, boosting hemoglobin, and much more. Iron overdoses are rare and most of the time, if there is more iron in the body than necessary, the body will save it for future use. SEM-EDX Spectra of Olax scandens is depicted in Figure 5.

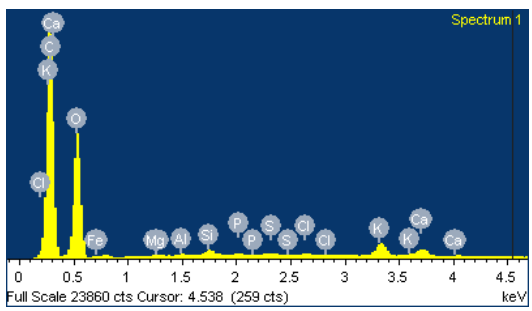

Figure5. SEM-EDX Spectra of Olax scandens

5. Conclusion

In this study, the observation of Olax scandens leaves in the SEM-EDX analysis, the result depicted that the highest concentrated element in the Olax scandens leave was carbon calcium, potassium and the second highest concentrated element was oxygen and other elements such as magnesium, aluminum, Silicon, Phosphorus, Sulfur, Chlorine, Potassium,

Calcium and Iron were also presented. In this study the Olax scandens leaves offers significantly not only compositional elements of life extension but also medical benefits.

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I would like to thank my Pro- Rector Professor Dr Myint Kyi, Yangon University for encouragement and I am also appreciative to my colleagues. Finally, I thank material science lab, Defense Services Technological Academy for taking transparent spectrum.

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Water Quality Assessment of Tube Well Water from Selected Area in Loikaw Region, Myanmar

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Abstract

In this research work, the tube well water in Loikaw University campus was selected for analysis of selected biophysicochemical parameters. In Loikaw University, tube-well water is used primarily as a source of recreation use. The physical and chemical properties of collected water sample such as color, pH, total dissolved solid (TDS), total hardness, total alkalinity, calcium, magnesium, and chloride were determined. Organic pollutant parameters such as DO (dissolved oxygen), BOD (biochemical oxygen demand) and COD (chemical oxygen demand) were also investigated. The content of heavy metals such as arsenic, lead and cadmium were determined by using atomic absorption spectrophotometer (AAS). The bacteriological examination of water samples were also investigated .According to the results, most of the physical and chemical parameters are within the range of WHO standard limits. In bacteriological examination of this sample, the probable coliform count was not observed in sample. The tube well water sample was free from arsenic and lead but cadmium content was found to be 0.5 ppm. Therefore, the cadmium content was outside the accepted limit recommended by the World Health Organization for drinking water. It can be concluded that tube-well water in Loikaw University Campus should be treated if it is used as drinking waters.

Keywords: tube well water, groundwater, DO, BOD, COD

1. Introduction

Water is the main constituent in the formation of all living things and its special properties are vital to the existence and growth of animals and plants. The amount of water used for drinking and household supplies varies greatly. In modern days, due to the increase in population and the greater awareness among the people of the importance of hygiene in their daily life, the amount of water for domestic use has greatly increased. Water is essential to human life and must be provided even if it does not meet all the desirable water quality standards. Water for drinking as well as food preparation and bathing must be free from organisms which can cause disease and from minerals and organic substances producing adverse physiological effects [2].

Groundwater plays an important role in various purposes such as domestic uses, industrial supply and irrigation in all over the

world. As a result of increasing in world's population, industrialization and urbanization may cause contamination of groundwater. The groundwater should not be used for drinking purposes until it has not been tested. Hence, it is necessary to protect quality of groundwater. According to WHO, 80% of diseases are arises due to groundwater contamination [4].

Chemical contamination of drinking water both naturally occurring and from pollution is a very serious problem. Arsenic and fluoride alone threaten the health of hundreds of millions of people globally. But even more serious is microbiological contamination, especially from human feces. Fecal contamination of drinking water is a major contributor to diarrheal disease. Globally, an estimated 2,000 children under the age of five die every day from diarrheal diseases. Almost 90% of child deaths from diarrheal diseases are directly linked to contaminated water, lack of sanitation, or inadequate hygiene [5].

There are a variety of trace elements present in virtually all potable water, some of which play a role in metabolism. For example sodium, potassium and chloride are common chemicals found in small quantities in most waters, and these elements play a role in body metabolism. Other elements such as fluoride, while beneficial in low concentrations, can cause dental problems and other issues when present at high levels. Drinking water or potable water is safe enough to be consumed by humans or sued with low risk of immediate or long term harm. Typical uses (for other potable purposes) include toilet flushing, washing and landscape irrigation [1].

In this research work, the tube well water sample was collected from Loikaw University Campus, Kayah state to determine the quality of groundwater.

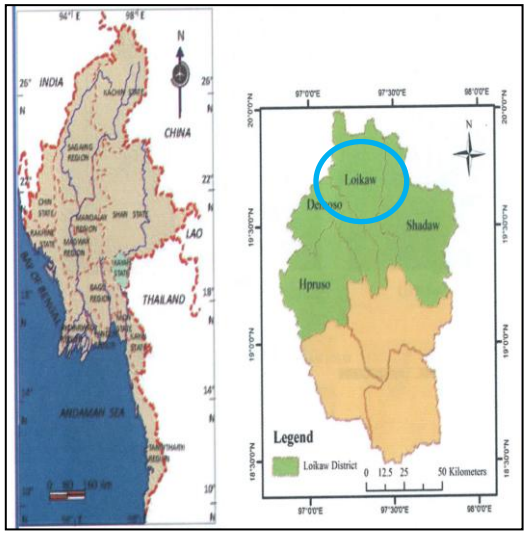

Figure 1. Location Map of Water Sample Collected Area

2. Materials and Methods

2.1. Sample Collection

The water sample was collected in sterile plastic bottles. Then two or three times with the bottles were washed with water which were to be collected. The tube well water sample was collected from Loikaw University campus, Kayah state on July. The depth of tube- well was 120fts.

2.2. Determination of Physical Properties of Water Sample

Determination of Colour

The color of tube well water sample was determined by platinum cobalt standard method (spectrophotometer) [3].

Color is determined by comparison of sample with known concentration of colored solution. It is the standard method, unit of color being that produced by 1 mg platinum/L in the form of the chloroplatinate ion.

25 mL of water sample was placed in the sample cell and the color was determined at 455 nm of dematerialized water as blank.

Determination of pH Value

The pH value of tube well water sample was determined by electrometric method by using pH meter. [3]

The basic principle of electrometric pH measurement is the determination of the activity of the hydrogen ions by potentiometric measurement using a glass electrode and reference electrode. The pH of a specific solution can be measured by a pH meter or by pH indicators. pH meter is an apparatus with electrodes sensitive to hydrogen (hydronium) ions. This instrument measures the small voltage produced by the presence of hydrogen ions and reads out the pH.

Electrodes were rinsed with distilled water and dried by gently cleaning with a soft tissue. The instrument was standardized by immersing electrodes in a buffer solution of pH 7. Then the pH of sample was measured by dipping electrodes after cleaning into well stirred for 1 minute.

Determination of Total Dissolved Solid

The total dissolved of tube well water sample was determined by evaporation method [3].

The evaporating porcelain basin was cleaned thoroughly with concentrated nitric acid and washed with distilled water. The basin was dried in an oven at 200°C for 1 hour. The basin was cooled, desiccated, weighed and stored in desiccators. 100 mL of water sample was quantitatively transferred to the preweighed basin and evaporated to dryness on a steam bath. Then the sample in the basin was dried in an oven at 103-105°C for 1 hour. The basin holding residue was cooled in desiccators and weighed. The process of drying, cooling, desiccating and weighing was repeated until the constant weight was obtained.

Determination of Turbidity

The turbidity of tube-well water sample was determined by turbidimetric method.

2.3. Determination of Chemical Properties of Water Sample

Total Hardness

The total hardness of tube well water sample was determined by EDTA titrimetric method [3]. 20 mL of the water sample was pipetted out into a clean conical flask. 5 mL ammonia buffer and 2 drops of EBT indicators are added and titrated against EDTA from the burette. The end point was the change of color from wine red to steel blue. For blank titration, distilled water was used instead of water sample.

Estimation of Total Alkalinity

The total alkalinity of tube well water sample was determined by acid-base titration titrimetric method [3].

20 mL of water sample was titrated with standard 0.02 N H_2SO_4 solution using ph-ph indicator until color changed from pink to colorless. Then, 2 drops of methyl orange indicator were added and the titration was continued until the color turned faint red orange.

Estimation of Calcium

The calcium of tube well water sample was determined by EDTA titrimetric method [3].

25 mL of water sample was mixed with 25 mL of distilled water. 2 mL of NaOH solution and 0.2 g of murixide indicator were added to the sample. The sample was titrated immediately with EDTA solution until the color changed as blank. EDTA titrant was added to the blank to procedure as unchanging color. For blank titration, distilled water was used instead of water sample.

Estimation of Magnesium

Magnesium can be calculated by the following formula [3].

Mg mg/L = [Total hardness as $CaCO_3$/L – Ca hardness as $CaCO_3$/L] × 0.244 × 1000.

Estimation of Chloride

The chloride of tube well water sample was determined by argentometric method [3].

10 mL of sample was mixed with 90 ml of distilled water. 1 mL of K_2CrO_4 indicator solution was added and titrated with standard $AgNO_3$ solution to a pinkish yellow end point. For blank titration, distilled water was used instead of water sample.

2.4. Determination of Organic Pollutant Parameters

Estimation of Dissolved Oxygen (DO)

The dissolved oxygen of tube well water sample was determined by the Winkler's method. The dissolve oxygen (DO) test measure the current oxygen level in water. [3].

Estimation of Biochemical Oxygen Demand (BOD)

The biochemical oxygen demand of tube well water sample was determined by titrimetric method. BOD was the amount of oxygen consumed by bacterial as they oxidized organic matter in water. [3].

Estimation of Chemical Oxygen Demand (COD)

The chemical oxygen demand of tube well water sample was determined by permanaganate method [3].

Analysis of Heavy Toxic Metals (Arsenic, Lead and Cadmium) of Tube Well Water Sample

The content of heavy metals (arsenic, lead and cadmium) of water sample was examined by Atomic Absorption Spectrophotometer. The arsenic, lead and cadmium of tube well water sample was determined by inductively coupled plasma method/AAS [3].

Determination of Bacteriological Examination of Tube Well Water Sample

Probable coliform count and *E.coli* of the water samples were measured at Public Health Laboratory, Mandalay.

3. Results and Discussion

Table 1. The Result of Physical Properties of Tube Well Water Sample

No.	Physical Parameter	Water Sample	WHO Recommendation*	
			Highest desirable level	Maximum permissible level
1	Color(Pt-Co)	5	5	50
2	pH	7.2	7 to 8.5	6.5 to 9.2
3	Total dissolved solids (mg/L)	850	500	1500
4	Turbidity(NTU)	3.88	5	25

According to the physical properties of tube-well water sample, the colour of tube well water sample agreed with the highest desirable level. The pH values of tube-well water sample was found to be 7.2 and hence they are said to be slightly alkaline. The total dissolved solid amount of tube-well water sample was higher than the highest desirable level. The turbidity of tube-well water sample was found to be 3.88 NTU.

Table 2. The Results of Chemical Properties of Tube Well Water Sample

No	Chemical Parameter	Water sample	WHO Recommendation*	
			Highest desirable level	Maximum permissible level
1	Total Hardness (mg/L)	105	100	500
2	Total alkalinity (mg/L)	545	200	950
3	Calcium (mg/L)	21.75	75	200
4	Magnesium (mg/L)	10	30	150
5	Chloride (mg/L)	50.8	200	600

According to the chemical properties of water sample, the amount of total hardness and total alkalinity were found to be 105 mg/L and 545mg/L.

The amount of calcium, magnesium and chloride of water sample was found within the range of WHO standard limits.

Table 3. The Results of Organic Constituents of Tube Well Water Sample

No	Chemical Parameter	Water sample	WHO standard*	EPA Std**
1	DO (mg/L)	2.5	-	4-6
2	BOD (mg/L)	1	6	5
3	COD (mg/L)	0.726	10	5

*World Health Organization standard for drinking water (2006)

**Environmental Protection Agency for domestic water (2003)

According to this table, the value of DO, BOD and COD of water samples were within WHO standard value.

Table 4. The Results of Heavy Metals in Tube Well Water Sample

No	Element	Water Sample	WHO Recommendation*	
			Highest desirable level	Maximum permissible level
1	Lead (ppm)	ND	0.3	1.0
2	Cadmium (ppm)	0.5	1	3
3	Arsenic (ppm)	ND	0.05	0.01

ND = not detected

According to the results of heavy metals, the tube well water sample was free from arsenic and lead, cadmium content was found to be 0.05.

Table 5. The Results of Bacteriological Examination of Tube Well Water Sample

No	Test	Water sample
1	Probable Coliform Count	0/5
2	*Escherichia coli* Count	Not Isolated

E.coli was not isolated from water sample.

4. Conclusion

In the present study, the physical properties, chemical and biological examination of water sample was carried out to assess the quality of water. The colour, pH, calcium, magnesium and chloride of the selected water sample were found within the range of WHO standard limits. The amount of total dissolved solid, total hardness and total alkalinity of water samples were existed between the highest desirable level and maximum permissible level.

In bacteriological examination of this sample, the probable coliform count was not observed in

sample and *E.coli* count was not isolated from water sample.

The value of DO, BOD and COD of water samples were within WHO standard value. According to the results of heavy metals, the tube well water sample was free from arsenic and lead, cadmium content was found to be 0.5ppm. However, according to this overall result, the quality of water is unsatisfactory. So, the tube well waters from Loikaw University Campus, Kayah State does not used for drinking purpose without treating.

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