Internship Report

On

Bangladesh Reference Institute for Chemical Measurements (BRiCM)

Submitted by

Tasmiah Hasan; Student ID: 19326022

Tanzina Islam Tanni; Student ID: 19326028

Rinki Bala; Student ID: 20326023

Zarin Hossain; Student ID: 19126011

BRAC University

Department of Mathematics and Natural sciences department

Microbiology Program

Date: 1/11/2023

Declaration

It is hereby **declared** that

- This internship report consists of our original work as a requirement of completing of our degree at BRAC University.
- We confirm that content of this report does not contain material that has been previously published or written by a third party, while the report represents our experience, observation and findings during internship in BRiCM, except where this is appropriately cited through full and accurate referencing.
- The report does not contain material that has been accepted or submitted by any other individual for any other degree or diploma at a university or any other institution.
- We have acknowledged all main sources of help and hereby we confirm the accuracy and honesty of the information presented in the report.

Student's Full Name & Signature:

Tasmiah Hasan

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Signature and Date

Rinki Bala

_____

Signature and Date

Zarin Hossain

_____

Signature and Date

Tanzina Islam Tanni

_____

Signature and Date

Letter of Transmittal

To,

Dr. Mala Khan

Director General (Addl. Charge)

Bangladesh Reference Institute for chemical measurements (BRiCM)

75, Laboratory Road, Dhaka-1205

Subject: Submission of Internship report.

Dear Sir,

With all due respect, we are Microbiology undergraduate students at BRAC University, Department of Mathematics and Natural Sciences. We served as an Intern in the laboratory of **Bangladesh Reference Institute for Chemical Measurements** (BRiCM) from 13/09/23 to 25/09/23 to fulfill the requirements of the course MIC400: Industrial/Research Organization Attachment.

The main goal of this report is to include all the necessary information and work on laboratories from our internship at Bangladesh Reference Institute for chemical measurements (BRiCM) in the briefest way possible. We sincerely hope that you will find the report to be satisfactory.

Sincerely,

Tasmiah Hasan

Student ID: 19326022

Tanzina Islam Tanni

Student ID: 19326028

Rinki Bala

Student ID: 20326023

Zarin Hossain

Student ID: 19126011

BRAC University

Microbiology Program

Ms. Fahmida Sultana	Dr. Mala Khan	Dr. Pranab Karmakar
Advisor	Director General	Advisor
BRAC University	BRiCM	BRiCM

Acknowledgement

We sincerely want to show our gratitude and acknowledgement towards BRiCM for the support and guidance they have provided us during our internship program. The whole experience has been invaluable and we want to extend our appreciation to the following person who one way or another contributed in making this internship possible Dr. Pranab Karmakar sir, senior scientific officer, for his immense support and word of encouragement and also for his valuable time which he managed for us from his busy work schedules. Furthermore, I would like to thank all of the other scientific officers, lab technicians for all of their valuable advices, suggestion and supervision that helped us a lot to learn effectively. Last but not the least, thanks to our entire group mates who helped us understanding and learn a bit more.

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Introduction

Bangladesh Reference Institute for Chemical Measurements commonly known as BRiCM is regarded as a key organization in Bangladesh for the standardization and measurement of chemicals. They are consistently working to increase the nation's production capacity by acquiring new technologies, transferring existing technologies, and developing unique technologies in order to achieve and sustain its status as a developing nation. To date, BRiCM has developed 3912 chemical measurement (analytical) services, 22 calibration services for laboratory and industrial analytical equipment, and 32 services for medical equipment used in medical diagnostic laboratories. Additionally, BRiCM organized 41 proficiency testing programs, participated in 7 international standardized testing initiatives, and developed 3 reference materials (pH Buffer, Diclofenac Na, & Acetaminophen). Due to its global reach and service offerings, BRiCM has not only established itself as a respectable player on the international stage but has also started to accumulate significant amounts of foreign currency.

In order to fight against the public health crisis like Covid-19, BRiCM has developed, manufactured and delivered hand rub, sanitizer, Covid-19 specimen collection kit (VTM), Bangasafe oronasal spray, a test service for Covid-19 specific antibody (IgG) and Genome sequencing of Coronavirus(TBS, 2023)

Figure 1: Bangasafe Oro-Nasal Spray

BRiCM duties are:

- Assigning Reference Values Using Different Parameter
- Standard Reference Material of Bangladesh
- Analyze the Presence of Total Bacteria and Characterization
- Reference Measurements Services for Domestic Product
- Proficiency Testing/ Inter-laboratory Comparison
- Instrumentation and Calibration Service
- Method Validation Services
- Training and Consultancy Service
- Contract Research Services
- Higher Degree Research Program Special Services
- Internship Program and Collaboration Work with Universities
- API Characterization of Pharmaceutical Industries
- Bioequivalence Studies
- Providing Authentic and Unbiased Report
- Antibody Resistance Test Report

The Reference Measure Division, PT Inter-Lab Comparison Division, Integrated Quality Compliance Division, Planning Division, Administration Section, and Accounts Section all collaborate to maintain the seamless operation of the institute outside of service offering. BRiCM labs include:

- Microbiology Lab
- Molecular Spectroscopy Lab
- Elemental Analysis
- Wet Chemistry Lab
- Atomic Absorption Spectroscopy (AAS) Lab
- Calibration
- HPLC
- GC-MS/MS
- LC-MS/MS

- Molecular Biology Lab
- ICP-MS
- Immunochemistry and Histopathology

Among allthese labs, during our 15 days of internship program we have visited microbiology lab, molecular biology lab, wet chemistry lab, atomic absorption spectroscopy lab, high performance liquid chromatography (hplc) lab and gas chromatography-mass spectroscopy (gc/ms) lab. BRiCM is an organization specialized in testing for halal certification, resistant bacteria, Legionella, Listeria, and other contaminants. In addition, all the domestic and foreign clients must request sample testing along with specific parameters. Another crucial part of their service is, none of their clients are able to communicate with the scientific officers andhave to keep the identities of sample donors a secret in order to prevent bias in test findings.

The organization has some long-term goals including:

- ✓ Through cooperation establishing the decentralized national chemical metrology infrastructure
- ✓ Global acknowledgement for promoting chemical measurement traceability

1. Microbiology Lab

A lot of tests are done in the microbiology lab. They work with different types of sample including, environmental, food, cosmeticand the lab testing are performed based onthe clients mentioned parameter. According to their analysis they have noticed few differences between the domestics and export quality products. For instance, their primary target is to look for the presence of E. coli, salmonella, coliform, total bacterial count, antibiotic resistance and any potential pathogens. Furthermore, they performedE. coli test, the endotoxin test, the production of cellulase enzyme for denim decolorization, the enzyme assay, the probiotic test, the development of the Dengue Kit, the detection of organisms in food and the disinfection test. Basically through microbiological tests their organization ensures whether the sample is safe and

suitable for human use. Sample analysis is done by following the ISO method mentioned in the logbook.

The microbiological lab has all the necessary equipment, enough parts, machines, and reagents, like a laminar flow, incubator, autoclave, and others, to run the tests and provide unbiased results.

1.1 Laminar Flow Cabinet

Laminar flow cabinet plays a significant role and frequently employed inside the microbiology lab, cell culture, and other biological research applications. It establishes an atmosphere with a regulated air flow to prevent samples from becoming contaminated. Environmental microbes can endanger the integrity of the experiment sample which can result an error prone research outcome. They are used when working with delicate materials, samples, or machinery that needs to be shielded from airborne contamination. Apart from microbiological field they are also utilized in pharmaceutical, electrical, and optical sectors, to ensure sterile working environment.

Usually, laminar flow cabinets are either vertical or horizontal, although both configurations have their own uses. The direction of the air flow varies depending on the cabinet whether it is vertical or horizontal. If the cabinet is vertical then air flows from top to bottom, and in case of horizontal, it flows from back to front. Both types of cabinets are available in a variety of sizes and layouts to serve a wide range of storage and display demands.

Figure 2: Laminar Flow Cabinet

1.2 Incubator

Incubator is laboratory equipment that provides a controlled environment like specific temperature and humidity for the incubation and growth of various microorganisms, such as cell culture, bacteria, yeast, and molds. It is an essential tool for microbiology and in the life science field. It ensures constant controlled temperature, humidity, gas content and other environmental factors for the cultivation of organisms or the storage of biological specimens.

In microbiological incubators a digital or analog temperature control system is typically found which enables users to establish and preserve a precise and consistent temperature. Although the temperature range varies based on the model and it is often adjusted to approximately 37 degrees Celsius (98.6 degrees Fahrenheit) in order to replicate the temperature of human body.

Figure 3: Incubator for cultivation of microbes

Certain incubators have humidity control feature to build a better environment for particular bacteria or research purpose. This particular feature is crucial while dealing with organisms that need higher relative humidity.

Today there are different types of incubators available, and depending on the job at hand, each has a unique set of benefits and drawbacks. Whereas CO2 incubators are used for cell culture applications that need a certain CO2 concentration, on the other hand, shaking incubators are used to cultivate cells that need agitation. Lab incubators are generally essential tools for maintaining biological materials and fostering the growth of live things.

1.3 Autoclave

An autoclave machine is used to disinfect tools, supplies, and media utilizing high-pressure steam and heat inside labs and other environments. Autoclaves are utilized in many different sectors, including as industrial production, microbiology, and medicine and surgery. Moreover, this device kills any bacteria, viruses, or other biological contaminants present in its contents by sterilizing them with high pressure and temperature. Maintaining a high enough pressure and temperature will eradicate spores, bacteria, viruses, and fungi.

Figure 4: Autoclave machine

For steam sterilization, 250°F (121°C), 270°F (132°C), or 275°F (135°C) are frequently suggested temperatures. The objects being sterilized must be exposed to these temperatures for the minimum amount of time advised by the manufacturer of the processing apparatus in order to destroy any microbes that may be present.

Autoclaves come in a variety of sizes and shapes; from small, tabletop models to massive industrial units that can disinfect tons of items at once. Programmable cycles, temperature and pressure sensors, and safety features to prevent overheating or pressure overload are a few examples of features and controls.

Other than sterilizing, autoclaves can be used for a variety of purpose such as bonding and curing materials at high heat and pressures. In case of workplace quality control as well as for sterilizing equipment, supplies, and media used in laboratories, autoclaves are irreplaceable.

2. Molecular Biology Lab

In the Molecular Biology lab, we have seen RT PCR, Gel electrophoresis devices. These devices were used to detect HBsAg, Dengue and many other diseases.

2.1 Principle

Reverse Transcriptase PCR is designed to amplify, identify or isolate RNA sequences. It converts RNA into its complementary DNA sequences by using Reverse Transcriptase. Concept of RT-PCR relies on the ability of DNA Polymerase to replicate specific DNA sequences in vitro. In this process, billions of copies of desired DNA can be made just from a single DNA template. RT-PCR process is faster than conventional PCR. Real-time PCR works quite similarly like conventional PCR. But it doesn't depend on the observation of bands in gel after the reaction. Instead of that, the process is monitored in real time. The whole process or reaction is placed into a real-time PCR machine that observes the reaction by using a detector or camera. Many different techniques are used to monitor the reaction of PCR, all of them have one thing in common. That is, all detection techniques in real-time PCR link the amplification of DNA to the production of fluorescence. This fluorescence can be easily identified by using the camera or detector during the PCR reaction. As gene amplification occurs, gene copies increase during the reaction. The fluorescence will also increase by the time of the reaction of PCR.

Figure 5: Real-time PCR Machine

There are three steps in this process of RT-PCR. They are- Denaturation, Annealing and Extension.

Denaturation: In this step, high temperature is used to melt or denature the double stranded DNA. This high temperature breaks the hydrogen bonds between the double stranded DNA and separates the DNA into a single strand. Usually, 95°C is the temperature that is used for denaturation. But the denaturation time can be increased if template GC content is high.

Annealing: After that, the sample mixture is cooled to a temperature of 50 to 60°C (122 to 140°F), which enables the DNA polymerase enzyme and primers to attach to the individual strands of DNA that the heat had separated.

Extension: The DNA polymerase is most active between 70 and 72°C, when primer extension can happen at up to 100 bases per second. In real-time PCR, this step is frequently paired with the annealing step, which uses a temperature of 60°C, when the amplicon is small.

2.2 Method:

- The RNA was successfully extracted from the biological sample using a proper protocol, and its quality and quantity were measured using either spectrophotometry or bioanalysis.

- By utilizing the reverse transcriptase enzyme, random primers, and dNTPs, the RNA underwent a transformation into complementary DNA (cDNA) within a reaction mixture.
- Next, the resulting cDNA was seamlessly incorporated into PCR tubes, along with PCR master mix containing Taq polymerase, forward and reverse primers, dNTPs, and buffer.
- The innovative RT-PCR machine then ran a series of PCR cycles, consisting of denaturation, annealing, and extension steps, effectively amplifying the cDNA.
- After obtaining the data from the RT-PCR machine, an in-depth analysis was conducted.
- The amplification plot provided a clear representation of fluorescence levels, which continuously intensified with each cycle.
- The Ct value, a crucial measuring point, was then used to precisely determine the quantity of initial RNA in the sample. To ensure accuracy, the data was thoroughly scrutinized by comparing the Ct value to either the standard curve or control samples.

It is crucial to adhere to the manufacturer's guidelines and recommended procedures for RNA extraction, cDNA synthesis, and PCR amplification. One of the powerful molecular biology method is RT-PCR that is known as Real time PCR. Reverse Transcription Polymerase Chain Reaction is a crucial tool in detecting and quantifying various RNA molecules; most notably messenger RNA (mRNA). Widely utilized in multiple fields of research, including gene expression studies, virology, and medical diagnostics, this technique is essential for its precision and reliability. Consistently calibrating and validating the RT-PCR machine is vital for achieving high performance and precise outcomes.

3. Wet Chemistry Lab

In Biochemistry wet lab we have learned about quantitive measurements of Carbohydrate, fat, sugar and protein. We have seen the measurement of Carbohydrate, fat, sugar and protein of Golapjamun (Sweet). In wet chemistry lab, water hardness, moisture, energy measurement, peroxide value, iodine value and many other tests are also done by the lab personnel.

Carbohydrate measurement: For Carbohydrate measurement of a particular product, by difference method was used in this lab. They followed a formula to count or measure the amount of carbohydrate.

3.1 For Moisture test

At 105°C certain weight was putted on the oven. To measure weight dried crucible was used. 2gm Sample of a particular product was taken and putted on oven in 105°C for 3-4 hours. Because of this high heat for long time, vaporization rate will be higher and all moisture of this product will go away. After the moisture have gone, the sample should be out of the oven and be cooled down. But it should not be kept outside for cooling down because the sample product will gain moisture from the environment again. That's why it should be kept in Dessicator. In desiccator, there is silica that can absorb water. By absorbing water, the silica will turn into pink colour.

For protein measurement, two methods are used. They are- KJELDAHL and DUMAS.

3.2 Protein Extraction:

Extraction of protein is an important process in wet chemistry lab. It involves the isolation of proteins from any product or sample for downstream analysis. To know the protein's structure, function and interaction with others, protein extraction is essential. There are several steps in protein extraction like cell lysis, solubilization and purification of protein. Based on the nature of sample and selected downstream application, different types of techniques are used for protein extraction.

Some of the methods of protein extraction includes- homogenization, grinding of the sample, sonication etc. Besides that, chemical treatments are also used for protein extraction. For chemical treatments- detergent, reducing agents, chaotropic agents are used to solubilize and stabilize the proteins.

Purification is another important part of protein extraction. After solubilization, proteins can be purified by using various processes like Chromatography, centrifugation, filtration or electrophoresis. These processes purify or separate the proteins based on their charge, size, hydrophobicity and other nature of the proteins.

After extraction of the proteins, purified proteins can then be analyzed, quantified and characterized by using several types of biophysical or biochemical techniques. These techniques include - mass spectrometry, enzyme assays and structural biological methods. All the

information or findings that gained from protein extraction can further be used by the researchers for various purposes like- developing new drugs, to better understand biological and chemical structure, to diagnose diseases etc.

- Protein extraction is used in clinical labs to determine disease like Diabetes by detecting the presence of insulin.
- It can be used for cosmetic purposes. For example- treatment of skin by collagen.
- In the field of research, protein extraction plays a vital role in downstream applications. Such as discovery of biomarkers, western blotting, gel electrophoresis, immunoprecipitations and enzyme assays.
- Purification of protein is very important for drug discovery and tissue-engineering.

3.3 Principle of protein extraction:

Protein extraction is the method which includes several steps for isolation or purification of protein from whole cells, tissues, cell culture or any types of biological fluids. This method developed with the assay's input and output. For this extraction, here Golapjamun (Sweet) is used. The purpose of this test was to check if the Golapjamun had the quantity of protein that was advertised on the pack.

3.4 Method:

For performing digestion, distillation and titration, The Velp protein extraction machine was used. The first reagent for application was a mixture of sodium sulphate and copper sulphate (9:1). Other reagents used in this process were- 35% Sodium chloride, 4% boric acid, sulfuric acid HCL. The solid samples were measured at 4gm and liquid samples were measured at 5ml. first of all, in the protein tube, 10gm of Sodium sulphate and copper sulphate mixture (9:1) was taken and digested in the velp machine with sulfuric acid. After that, titration was carried out to observe the colour change for determining the amount of protein present in the sample. From the colour observation, the deeper the green colour the greater the concentration of protein. To ensure the accuracy of measurement, this process was repeated for three times. This velp machine was provided with a percentage of protein content. The resulting protein percentage was accurate and same as the amount that was labelled on the product.

Sample: Sweet (Golapjamoon)

Instruments:

1. Digestion unit
2. Distillation unit
3. Analyzer of element

Reagents:

1. Na_2SO_4
2. Cu_2SO_4
3. H_2SO_4
4. 4% Boric acid
5. 35% NaOH
6. 0.1- 0.2 N HCl
7. Methyl red 3.5 ml
8. Bromocresol green 5 ml
9. Distilled water

Equipment/Machines:

1. Automatic nitrogen protein Analyzer (VELP Scientifica)
2. Automatic digestion unit

Sample preparation:

1. 2gm solid sample was taken and the mixture of sodium sulphate and copper sulphate (9:1) was added to it.
2. Then, 15 mL H_2SO_4 acid was added and it was placed on to automatic digestion unit at 300-420ºC temperature for 2 hours and 20 minutes.
3. One blank and three replicas were prepared.

Further processes: Protein Analyzer

1. After the digestion, selected sample was place on an automatic nitrogen protein analyzer to analyse protein.
2. Before starting the procedure, the protein analyzer was washed 3 times to remove dirt or previous substances.
3. All the compartments of the automatic analyzer were filled with the mixture of Sodium sulphate and copper sulphate (9:1). Na_2SO_4 maintains stability and $CuSO_4$ helps the oxidation.
4. After this procedure, a sample was placed and prepared for titration and titration started.
5. Reading from the Velp machine was recorded carefully.
6. Before switching to another sample, the sample holders were replaced carefully.
7. Protein detection formula of this process, P% = {(Titration volume- blank) x 1.4007x protein factor} /sample weight.

Figure 6: VELP machine to analyze the percentage of protein.

Result: The test result given the same percentage of protein that was labeled on the packet of Sweet (Golapjamun).

Sugar separation test: To analysis the amount or presence of sugar in the product that is Sweet (Golapjamun) sugar separation is necessary. It requires some steps to get the result for sugar analysis.

Reagents:

1. Potassium-sodium tartrate
2. NaOH
3. $CuSO_4$
4. Pb acetate (Saturated)
5. Na Oxalate
6. Phenolphthalein

Sample Preparation:

1. For solid sample, 2.5 gm was taken. For liquid sample, 10 ml will be used for test.
2. 2.5 gm sample was taken in 100ml volumetric flask for dissolve in water.
3. One blank and three replicas were prepared for sugar analysis.

Method:

1. the 2.5 gm sample was dissolved in 100 ml water in a volumetric flask.
2. 2ml saturated Pb acetate was then added into it.
3. After that, 50-100 milligram Na oxalate was added.
4. Then the whole mixture was filtered with filter paper and collected 50ml of the liquid portion in another flask.
5. In that liquid, 10ml HCl was added and the mixture of the liquid was kept in room temperature for 24 hours.
6. After 24 hours, it was made neutral by adding 2-3 drops of Phenolphthalein.
7. Then, NaOH slowly added until it turns pink.
8. When it was turned into pink color, distilled water was added until the amount of the solution turned into 100 ml.
9. 75ml solution was discarded.

10. Then 25ml $CuSO_4$ and 25 ml Na tartrate was added.
11. Again, 25ml distilled water was added into it until it made a 100 ml solution.
12. Then, the mixture was putted on the water bath for 10 minutes at 100°C.
13. If there is the presence of Sugar, it would turn red. But if the sugar is absent, it will turn into a blue color.

Result: The mixture was turned into a red color because it had enough amount of sugar that was indicated on the pack of the product.

4. Atomic Absorption Spectroscopy (ASS)

Atomic Absorption Spectroscopy (AAS) is a technique that is used in order to determine the concentration of heavy metals present in a sample. It is a quantitative analysis. This laboratory is located on the first floor. The three primary spectroscopy machines we have seen there are FAAS (Flame atomic absorption spectroscopy), GFAAS (graphite furnace atomic absorption spectrometry), and ICP-OES (Inductively coupled plasma optical emission spectroscopy). Metals for example calcium, magnesium, sodium, iron, manganese, and other heavy metals can be detected through the technique. The three type of machines are being chosen depending on the sample matrix. The entire process includes sample digestion, sample preparation, standard preparation, and lastly sample run on the machine.

4.1 Sample Preparation

Microbe digestion system is being used in order for sample preparation. 0.2 gm of solid sample or 0.5 of gm liquid sample is being taken and mixed with 8 ml pure form of nitric acid. Then the mixture is being run through microbe digestion system for around 20 minutes at 7000-8000 °C. After that, filtration is done. After filtration, minimum 2-5 ml of sample is being taken for the sample run on the machine.

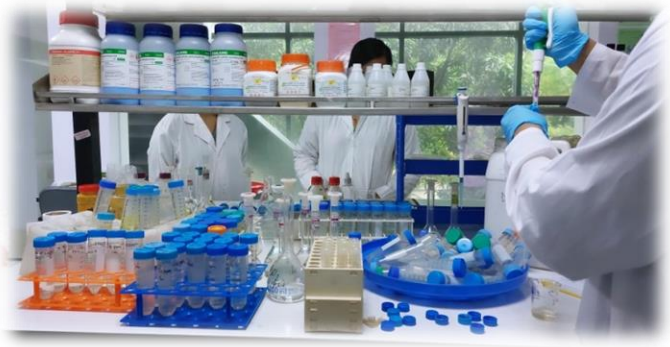

Figure 7: Sample preparation.

4.2 Materials and Instruments

Machines:

- FAAS
- GFAAS
- ICP-OES machines

Reagents:

- Nitric Acid
- Distilled water
- 0.2 gm of solid sample or 0.5 of gm liquid sample

Equipments:

- Volumetric flask
- Beaker
- Pipette
- Falcon tubes

4.3 Method

Standard run

↓

Software setup

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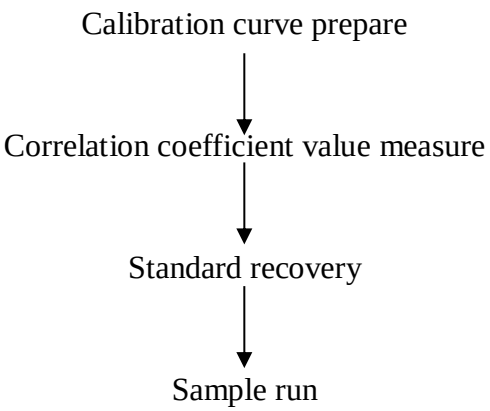

Figure 8: Flame atomic absorption spectroscopy (FAAS)

Figure 9: Graphite furnace atomic absorption spectrometry (GFAAS).

Figure 10: Inductively coupled plasma optical emission spectroscopy (ICP-OES).

5. High-Performance Liquid Chromatography (HPLC)

HPLC (High-performance liquid chromatography) is a quantitative analysis used in biochemistry and analytical chemistry for the separation, identification and for quantifies the components present in a liquid mixture. HPLC is called the universal separation technique as this technique has the capability to detect and separate polar, non-polar all type of compounds.

Figure 11: High-Performance Liquid Chromatography (HPLC).

5.1 Components

The major components of HPLC includes-

- Mobile phase
- Pump
- Auto injector
- Column
- a detector
- Data analysis device.

5.2 Method

A liquid sample is being injected into a stream of solvent in order to be dissolved. Mobile phase is a liquid that dissolves the target components. After that, it passes through a column. The stationary phase is a part of the column that interacts with the target components. Different components of the sample interact differently with the stationary and mobile phases that results in separation of the components based on their physical and chemical properties.

5.3 Instruments

While visiting the HPLC lab, we have observed six types of HPLC machines. They are-

- conductive Or ion detector
- preparative detector
- reflective index detector
- PDA (photo dye array) detector
- Fluorescence detector
- UV detector

6. Gas Chromatography-Mass Spectrometry (GC-MS)

6.1 Principle

The capacity of gas chromatography technology to separate components first, as well as the ability of mass spectrometry to discover, identify, and measure organic volatile chemicals in complicated mixtures. It combines two independent techniques, one of which is gas chromatography (GC) and the other is mass spectrometry (MS).

The sample is first placed in the GC column, which separates the various components of the sample based on how they react physically and chemicallyas such based on size, polarity temperature. The isolated chemicals are then ionized by the mass spectrometer. This results in a distinct mass spectrum for each molecule. The mass spectrum functions similarly to a fingerprint in that it may be used to identify and quantify each component of the sample. It is also capable of detecting minute quantities of chemicals in complicated combinations. This method separates compounds in a mixture based on their affinity for a stationary phase, which is commonly a liquid or solid coating on the interior of a capillary column, and a mobile phase, which contains the inert gas helium. Compounds with differing chemical characteristics will move at various

speeds across the column, resulting in separation. Each chemical has a retention time, which is the amount of time it takes to move through the column and reach the detector.

The process of mass spectrometry ionizes molecules, fragmenting them into charged ions. Typically, this is accomplished by the utilisation of processes such as electron encroachment (EI), chemical ionisation (Ci), or electrospray ionisation (ESI). The proficiency of ionisation used is determined in the case of meat being studied. The mass analyzer is a handy tool for separating ions produced by the ionization source, relying on their unique mass-to-charge ratio (m/z) for differentiation. Mass analysers that are oftentimes used include quadrupole, time-of-flight (TOF), and charismatic sphere analysers. The set-apart ions are detected, and the ensuant Mass spectrum demonstrates the teemingness of ions at dissimilar m/z values. Each chemical substance creates a trenchant Mass spectrum, which may be used to identify the component.

Figure 12: Gas Chromatography-Mass Spectrometry (GC-MS)

6.2 Method:

- First, the material is prepared for analysis. This might entail extracting substances of interest from a solid or liquid sample, then concentrating and purifying them.
- The prepared sample is typically injected into the GC column using a syringe or an auto sampler. The sample is vaporized by the injector and carried into the column by the carrier gas.

- The mass spectrometer precisely measures the spectra of all chemicals present in the sample. Through meticulous comparison against established standards and libraries, the data is meticulously evaluated to accurately identify and measure the quantities of the chemicals.
- From these findings, a detailed report is generated, including the substances detected, their concentrations, and any additional noteworthy data.
- The sample is separated into distinct chemicals as it traverses through the GC column, producing a chromatogram that records the precise retention times.
- The GC column effluent is then expertly injected into the MS, where ionization and mass analysis provide further insight into the exact components of the sample.

The diverse applications of GC-MS range from environmental monitoring to crime scene investigation, drug testing, and metabolomics research. Its remarkable sensitivity and specificity in detecting and measuring chemicals enables it to identify even trace amounts of molecules. Small compounds such as medicines, metabolites, and environmental contaminants are easily identified using GC-MS. The process is very simple to replicate and may be programmed to swiftly examine large amounts of data.

Limitation

- We did not have authorization to all the instruments and could not directly use to acquire results as most of the instruments and materials were quite expensive and if any mistake occurs, it might cost a lot to recover the situation.
- We were unable to take actual pictures of the instruments at BRiCM as the authority did not allow us.

Conclusion

To sum up, the internship we did in Bangladesh Reference Institute for Chemical Measurements (BRiCM), was a totally new accomplishment for all of us and we have acquired a fair amount of knowledge. Throughout this journey of learning we have come across a lot of microbiological and biotechnological instruments along with their practical use. We not only introduced with learning objectives related to our field but also we met new people, cooperatively worked as a team during that period and learnt together within harmony. All of us tried our best to utilize this

opportunity and learned as much as we could during this short period we stayed at BRiCM. Special thanks to Dr. Pranab Karmakar for guiding us throughout the journey.

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