A Dissertation on

Food Packaging Materials: Application, Paradigms Shifts in Development Strategies with Toxicological Relevance

Submitted to the

Department of Bioengineering

Faculty of Engineering

Integral University, Lucknow

In partial fulfilment

for the

Degree of Master of Technology

In Biotechnology

By

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M. Tech Biotechnology 4th semester

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DECLARATION FORM

I **Bhoomika Varshney**, a student of **M. Tech Biotechnology)** (2nd Year,4th sem), Integral University have completed my six months dissertation work entitled **“Food Packaging Materials: Application, Paradigms Shifts in Development Strategies with Toxicological Relevance”** successfully from **CSIR-IITR** under the able guidance of. **Dr. V.P. Sharma, Chief Scientist and Professor of AcSIR.**

I, hereby, affirm that the work has been done by me in all aspects. I have sincerely prepared this project report and the results reported in this study are genuine and authentic.

Bhoomika Varshney
Date

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CERTIFICATE BY INTERNAL ADVISOR

This is to certify that **Bhoomika Varshney** a student of **M. Tech (2nd/4th Sem),** Integral University has completed her six months dissertation work entitled **"**entitled "**Food Packaging Materials: Application, Paradigms Shifts in Development Strategies with Toxicological Relevance"** successfully. she has completed this work from CSIR-Indian Institute of Toxicology Research under the guidance of **Prof. Dr. V.P. Sharma, Chief Scientist and Professor of AcSIR, CSIR - Indian Institute of Toxicology Research, Lucknow.** The dissertation was a compulsory part of her **M. Tech, Biotechnology.**

I wish her good luck and bright future.

Dr. Aisha Kamal
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TO WHOM IT MAY CONCERN

This is to certify that Bhoomika **Varshney,** a student of **M. Tech Biotechnology** (II year/ IV semester), Integral University has completed her six months dissertation work entitled **"Food Packaging Materials: Application, Paradigms Shifts in Development Strategies with Toxicological Relevance"** successfully. She has completed this work from CSIR- IITR, Lucknow under the guidance of **Dr. V.P. Sharma Chief Scientist and Professor of AcSIR, CSIR - Indian Institute of Toxicology Research, Lucknow** The dissertation was a compulsory part of her M. Tech Biotechnology**.**

I wish her good luck and bright future.

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Date Bhoomika Varshney

Palace: Lucknow

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LIST OF ABBREVATIONS

AAS	Atomic Absorption Spectrometer
BIS	Bureau of Indian Standard
CSIR-IITR	Council of Scientific and Industrial Research- Indian Institute of Toxicological Research
EPA	Environmental Protection Agency
FDA	Food Drug Administration
GFRP	Glass Fibre Reinforced Plastic
GLP	Good Laboratory Practices
GMP	Good Manufacturing Practices
gm	Gram
HAI	Healthcare- Associated Infections
HDPE	High Density Polyethylene
ICU	Intensive Care Unit
ILAC	International Laboratory Accreditation Co-operation
IS	Indian Standard
ISO	International Organizations for Standards
LDPE	Low Density Polyethylene
ND	Not Detectable
NABH	National Accreditation Board for Hospitals and Healthcare
nm	Nanometer
OD	Optical Density
OECD	Organization for Economic Co-operation and Development
PET	Polyethylene Terephthalate
PPM	Parts PER Million
PVC	Poly Vinyl Chloride
PC	Poly Carbonate
QMS	Quality Management System
WHO	World Health Organization

1.Introduction

Packaging is very essential for every product. Without packaging product cannot be stored or transported.It gives the identity to the products. Packaging is the process that provides the protection during handling transportation and relevant information to all concerned products and gives a new outlook to the product. It keeps a product marketable and secure, while also help in its identification, description, and promotion. Packaging is the process of enclosing the product using science, art, and modern technology or protects the product in the distribution, storage, sale, use, process of design, evolution, production and other purposes. The importance of packaging material such as Wrapping product to look attractive, to safe the product from contamination, Protect the product while passing through distribution channels, holding together the contents, to provide physical protection, to enable marketing, to convey message to provide convenience, to enhance Brand Image, to enhance profits

Packaging material plays a vital role in food industries. Presently, eco-friendly packaging is used in food industries to protect or processing of food products. It prevents the product spilling or leaking, and protect the food from microbial contamination. Packaging is a crucial tool for maintaining food quality, minimizing food waste, and lowering the number of preservatives in food. It also plays an important role in keeping the food contained, guarding against physical and chemical harm, and provides vital information to consumers and marketers they need. Additionally, it also offers an important platform for manufacturers to communicate details about the characteristics of their products, nutritional contents, and their ingredient information

In most of the cases plastic is used as a packaging material due to its unique quality such as low cost,light and flexible. It also promotes the food safety and shelf life and facilitates the transportation of products.

Plastic is a type of synthetic or natural polymer and widely used in packaging sectors. Plastic is an English word that is originated form Greek word **“plastikos”** which means to form, shape or capable of being deformed without rupture. Plastic is a type of polymer which made up of repeating units of monomers and additives.

Over the last few years, the production of synthetic polymers has increased sometimes with the help of natural substance like cellulose, petroleum and other fossil fuels. Synthetic polymers are nothing but a long chain of carbon atoms, which arranged in repeating units or form. It is the long chain of carbon atoms which are arrange in array pattern. Due to these, polymers are strong light weight and flexible so these polymers are easily used in plastic.

Due to these properties polymers are widely used in every sector and has become a very important part of our life.

In 1869, first synthetic polymers were invented by John Wesley Hyatt. By the discovery of synthetic plastic, a new era of world start that changed the human life completely. Nature gives as so much things such as wood, metal, stone, bone, tusk, and horn but now a new material was synthetic by humans. This new invention changed not only humans' lives but also the outlook of the environment.

Plastics permeate every aspect of human life, including packaging, agriculture, water transportation, building construction, telecommunications, education, medical care, transportation, defense and consumer durability. One of the reasons why plastics are so popular is due to the wide variety of properties that plastics exhibit due to their ease of processing. As a result, the demand for plastics is increasing exponentially and it became a very important part of modern living standards. Because whenever we are purchasing anything, they are using plastics to wrap or pack them.

Many things cause harmful effects to the environment, among that plastic is the one that causes nowadays very harmful effect to the environment. If we see around us so we do the use of plastic in everyday life. For example - toothbrushes, plastic bags, tiffin, plastic bottles, etc.

Plastic is a non-biodegradable material. Recycling garbage is necessary because breakage of plastic bags into small pieces takes too much time and it is made up of very toxic chemicals. And if we burn the plastics which is thrown and the smoke which comes from burning causes very toxic effect to the environment. All plastics have a permissible limit. If plastic gets to mix with the permissible limit, then there is no harmful effect but if it gets increased then it is harmful to all the living species and the environment.

Plastic recycling may partially replace unused plastic as a source of raw materials in the manufacture of plastic products. The use of plastic monomers and additives such as plasticizers, stabilizers, dyes, flame retardants and fillers should be restricted as they can affect human health and ecosystems. The Phthalic acid esters (PAEs) and stabilizers viz. bisphenol- A, Organotin compounds are well known because of several toxicological implications on flora and fauna.

The usage of plastic has been increased day by day so the plastic pollution will increase because plastic takes thousands of years for its degradation. Some additives are also added

during its manufacturing. These additives will migrate and will cause a worst impact to human beings and cause different diseases. If we will burn the plastic for its degradation, it will increase the atmosphere temperature that is also very harmful not only humans, plants but also for environment.

When plastic does degrade, it released toxins that can be poison for the soil, rendering local and infertile. During its degradation period it will convert into microplastic and nano plastic that is also very harmful for society, environment and human being.

To consider all these points a novel non-toxin plastic is come in the market that is Bio bioplastic. Presently, there are lots of techniques are material are used in the society to replace the plastic. Government takes a lot of steps of overcome the usage of plastic.

Bioplastic is a made up of polymer like plastic but polymeric compound of bioplastic is degradable and synthesis by renewable biomass, such as vegetable, fats, oils corn starch, straw, woodchips, sawdust recycled food waste etc, direct from natural source such as polysaccharides, protein and chemicals viz sugar derivatives such as lactic acid, lipids etc. and from biological source of bioplastic polymers is microbes. It is commercial produces from renewable resources. One advantage of bioplastic over the plastic is that its polymers are independent from fossil fuels. The degradability or non-degradability of bioplastic are depending upon the molecular structure, chemical backbonestructure of the polymer such as Bio PET (Bio polyethylene) and degradable bioplastic such as polylactic acid, polybutylene succinate or polyhydroxyalkanoates. Different bioplastics have different structure thus it cannot be assumed that bioplastic in the environment will readily disintegrate. It easily recycled like plastic and avoid plastic pollution.

2. Review of Literature

In 1996, Zakład Badania et.al, performed an experiment on 33 sample of plastic packaging material to determine the global migration. To performed this experiment, they prepared model fluid simulants of fatty food such as 50 % isooctane and 96% ethanol. After the simulant preparation they performed experiment and observe the result during whole experiment they fellow EGW commission. **In 1995, Roczniki Panstwowego et.al.** performed an overall global migration to test polypropylene, polyethylene, polystyrene foils softened polyvinyl chloride foils and polyethylene. They took 37 packaging sample and performed experiment. During their experiment they prepare fluid model simulants recommended by the EEC directives. After completed the experiment they observe the result and accepted the value below the 10mg/dm2.

In 2004, Cwiek-Ludwicka K et.al. performed overall migration test in food packaging material. They prepared food simulants according to EU commission. They prepared the simulants of distilled water and 3% acetic acid and performed result and observe the result migration value accepted below the 10 mg/dm2.in acetic acid simulants they observed the value exceed the permissible limit but in distilled water value observed below the permissible limit so the application of food packaging materials is limited in case of acetic acid containing food items.

In 2019, Ohidul Alam et.al. performed an experiment to analysis the heavy metal in plastic bags. They took different types of plastic materials such as PE, HDPE, LDPV and PVC and analysed the different selected heavy metals as Pb, Cr, Cd, As, Cu etc. by the help of ICP-OES instrument. During their experiment they took 36 samples of different plastic packaging material.**In 2006, Marcelo Enrique Conti** published his work on the estimation of heavy metal especially Pb, cd, and Hg in book of CRC publication. They performed their experiment by the help of sensitive, fast, accurate, precise analytical methods. **In 2011, Cwiek-Ludwicka K et.al.** studied and experiment to analysis the primary aromatic amines and to determine the migration from food packaging material. During his experiment, they followed EU legislation.**In 2016, A E M. Khalil et.al** performed an experiment to test the overall global migration in High-density polyethylene that is used in traditional bakeries. They performed their experiment in two different temperature such as 70ºC and 100ºC and two different simulants distilled water and 3% acetic acid and performed three sample A, B, and C and performed overall global migration test and observed and compared the result in all three samples.**In 2018, Tatiane Malina Guerreiro et.al** performed an experiment to test the overall migration plastic packaging material into meat products. Migration process is a time- taken process and depended upon several factor. Migration test are performed with food simulants. Because real condition is highly impaired with this simulant condition. A number of techniques are used to test the overall migration process but an ideal process should be capable the migration of compound in real sample with fast and reliable results. So, Mass spectroscopy consider a most reliable and accurate process to analysis the migration result. To analysis the migration process in meat product they were use Mass spectroscopy and analysis the result.**In 1995, Kalacova, J et.al,** studied on the single component plastic films. They used distilled water, acetic acid, ethanol and olive oil as model food simulant to observed the overall migration process. migration process was determined at 40 to 150ºC and observed the result.

Plastic Packaging material as a part of emergency kit. In the United States and Europe, the most common packaging material for single serve, non-carbonated bottled water was found to be PET plastic. And PET plastic was found to be 100% recyclable.

In 2014, in the United State, 1.8 billion pounds of post consumers PET packaging pottles were collected and the Europe union 1.75 million metric tons (3.9 billion pounds) were collected. And by both the countries PET plastic was found to be most recycled. Since everyone is taking care of environment also so most of the companies has started the recycling process for used bottles. In 2014, USA has 31.8% and in the European union it was approximately 52%.

In India BIS has their own guidelines for packaging. Which works with aegis of ministry of consumer affairs, food & public distribution, Government of India. All the thing which are being packed like food packets and all, most commonly running by the U.S. food and drug administration (FDA) by the laws. It was found that the FDA regulation for bottled water must be at least as inflexible as the environmental protection agency (EPA) standards for tap water.

In India, the bottled water industry witnessed a boom in the 1990s as Bisleri launched the packaged drinking water in the country. This significant growth proved the industry players that the bottled water is pure and healthy.

The United States is the second largest consumer of packaged water, followed by Mexico, Indonesia and Brazil. Later, in the United States, bottled water and tap water were regulated by various agencies such as such as the F&D Administration (FDA) which regulates bottled water, Environmental Protection Agency (EPA) which regulates the quality of the LBWA, international bottled water association, HQ in Alexandria, Virginia . Bottled water is sold for a variety of reasons, including poor tap water quality, taste, and safety concerns. Most water bottles are made of recyclable PET plastic, and some bottles will eventually be landfilled.

In All spheres of life, application of plastic and polymers is increasing rapidly in our country.

Polyethylene terephthalate (PET), polyethylene (LDPE/HDPE), polycarbonate, polypropylene are the plastic which are generally used for packaging. Endocrine disruptor chemicals are a group of chemicals used at the time of manufacturing which has been identified and cause adverse health effects in human beings which include PCBs, Bisphenol-A, Diethyl phthalate, diethyl hexyl phthalate and heavy metals and much of our exposure to endocrine disruptors also occurs through what we eat and drink in some cases, chemicals such as plasticizers also migrate from food or beverage packaging. cals such as plasticizers also migrate from food or beverage packaging. The potential inclusion of these chemicals in commonly consumed beverages has been the focus of two recent European studies that have found evidence of estrogen activity in bottled beverage water. Both studies focus on the estrogenic effects of PET plastic mineral water bottles. BPA stands for bisphenol-A. it is a certain type of chemical used to make many things related to plastic and resins. It is also contained in polycarbonate plastic and epoxy resin, and polycarbonate plastic is used for containers used for storing food and beverages. BPA is also used in consumer products. Epoxy is also used to coat the inside of metal products such as food cans, bottle caps and water pipes. BPA also affects children, babies, and their brains and prostate. It also affects the behavior of the child. However, according to the US Food and Drug Administration, BPA is safe even in very small amounts in some foods. At room temperature, the concentration of BPA transferred from the polycarbonate bottle ranged from 0.2 to 0.3 mg / l. other plasticizer such as dimethyl phthalate (DEP) is a synthetic substance that is used to increase the flexibility of plastics and also used to make toothbrushes, automobile parts, toys and food packaging material. And Diethyl hexyl phthalate (DEHP) is also used in PVC.

However, few studies have shown that the release of antimony and other metals from recycled polyethylene terephthalate PET bottles can cause health concerns. In polymers various metal compound are also used as a stabilizers and colorants which include inorganic lead compound, cadmium, organic tin compound, zinc carboxylates and antimony compound. In materials science and engineering, multiple uses of plastics make products and consumer goods cheaper, lighter, stronger, safer, longer lasting, more versatile and improve our quality of life. Packaging is a technology by which we protect the products from contamination and damage. Packaging material means wrap or protect goods and materials it helps the product safe and marketable. Packaging is important for the design, examination, syndication, storage, sale of the products. Different types of products need different types of packaging material such as paper, plastic bottles, glassware etc.

Plastic material widely using as a synthetic and semi-synthetic packaging material. Polymers are the main ingredient of the plastic material. Rather than polymers there are some additives also add for making the plastic packaging material.

One hand Plastic is a precious gift of the science to the society and its usage increases day by day but another hand, plastic waste increase and it will cause plastic pollution and its polymers are nondegradable it will cause toxic effect to the society, animals and environment and causes pollution such as land pollution, microplastic cause plastic pollution in water.

To overcome this problem new innovating biodegradable polymers are using in plastic industries these polymers are completely degradable and does not cause toxic effect to the society, animals and environment. This type of plastic is known as Bioplastic. These plastic materials are made up of renewable sources such as vegetable fat, oil, corn starch etc. some bioplastics are obtained from natural resources such as polysaccharides, protein and so on.

Presently bioplastic and paper are most widely used packaging material after plastic. Approximately 34 % packaging material paper and board are as a packaging material.

3. Aim and Objectives

1. To understand the importance of suitability evaluation of plastic consumable items and relevance of quality assurance during experimentation of R&D studies
2. Estimation of Physicochemical Analysis of Food packaging material
3. Estimation of Global Migration in Food packaging material
4. Estimation of Heavy metal in Food packaging material
5. Estimation of UV- absorbing material in Food packaging material
6. Understand the basic concept of Quality Control Management

4. Materials and Methods

4.1 Testing Parameters

4.1.1) Physiochemical Analysis

1. Changes in physical state
2. Estimation of overall global Migration
3. Estimation of UV-absorbing material
4. Estimation of Heavy Metals
5. Estimation of Oxidizable metal

4.1.2) Biological Tests

1. Estimation of systemic injection test (biological tests)

4.1.1. Physiochemical Analysis

4.1.1.1. Changes in physical state

In this parameter, we see various changes in packaging material. If any food packaging material plastic is exposed to model food simulants such as Acetic acid, Nacl, and distilled water at different temperature according to our requirement mainly in case of food sector we generally prefer 40ºC and 60ºC. and observe the physical changes such as weight, color, pH, odour etc.

4.1.1.2. Estimation of overall migration

5.Table No: 01 Guideline for Packaging Material

<table>
<tr><th>Product /Material of test</th><th>Specific Test Performed</th><th>Specification against Which test are performed</th><th>Limit of its operation</th></tr>
<tr><td rowspan="10">Packaging Material</td><td colspan="3">Physicochemical Test</td></tr>
<tr><td>Global Migration Test</td><td>IS: 12709: 1994, Clause 16, IS 9845:1998</td><td>Total residue in 100ml of the extract should not exceed 5 mg</td></tr>
<tr><td>Heavy Metal Estimation</td><td>IS: 12709, 1994 Clause16</td><td>Metal up to ppm levels. Concentration of Pb, Cr, Zn, Ni, should not exceed 0.1 ppm</td></tr>
<tr><td>UV absorbing Material</td><td>IS: 12709, 1994 Clause16</td><td>Optical density should not be below 0.3</td></tr>
<tr><td>Oxidizable Material</td><td>Indian pharmacopeia</td><td>Difference of the Sodium thiosulphate consumed should not exceed 2ml</td></tr>
<tr><td colspan="3">Physical State</td></tr>
<tr><td>Physical State</td><td colspan="2">No Changes</td></tr>
<tr><td>Color Extract</td><td colspan="2">No Changes</td></tr>
<tr><td>Odour</td><td colspan="2">No changes</td></tr>
</table>

After packaging the food items, the chemical/additives which is present in the plastics packaging material came contact with food and migrate into the food items and cause a worst impact on the food and cause different disorder and this process is known as migration and overall migration which includes migration of inorganic compounds such as heavy metals, organometallic compounds. Test of global migration has been conducted by various national and international agencies.

4.1.1.3. Estimation of UV absorbing materials

UV-Spectrophotometer: - A spectrophotometer is an instrument that measures the number of photons (the intensity of light) passes through sample solution. Over a certain range of wavelength all chemicals compound absorbs, transmit or reflect light. Using the UV-spectrophotometer, we get absorption peak 200-400nm. The commonly used UV absorbing materials are derivatives of benzophenones, Salicylates, Acrylate, organonickel and amines which are added during the synthesis of plastic to protect them from degradation by sunlight and fluorescent lighting. UV absorbing materials in the plastic extract is essential as some of these compounds are toxic.

4.1.1.4 Estimation of heavy metals

By the help of Absorbing Atomic spectrophotometer, we analyzed the heavy metal such as Co, Cd, Cr, Pb, Mn in packaging material.

4.2 Material/Reagent required for study

4.2.1Material Required

We collect the food packaging Plastic and Bioplastic sample from the market, Scale, Scissor, Marker.

A. Glassware Required

- Reagent Bottle
- Beakers
- Measuring cylinder
- Crucible, Desiccator
- Test Tube
- Conical flask
  0Burette
- Funnel
- Pipette

B. Reagents Required

- Potassium Permanganate (Kmno4)
- Sulfuric Acid (H2SO4)
- Potassium iodide (kl)
- Sodium thiosulphate (Na2S2O3)
- Starch solution
- Nitric acid
- Acetic acid
- Normal saline (NaCl)

C. Instruments Required

- Temperature /humidity meter
- Hot air oven
- PH meter
- Electronic analytical balance
- Muffle Furnace
- Hot plate
- UV-Spectrophotometer
- Atomic absorption spectrophotometer

4.2.2 Instrument

a) Temperature / humidity meter

Temperature/humidity meter is a device used to measure environmental conditions, temperatures and humidity of the laboratory.

Figure No: 01 Temperature / humidity meter

b) Hot Air Oven

Hot air oven is an instrument which is used to destroy microorganism present in the material which is kept for sterilization and dry the glassware such as Petridis, pipette, flask and test tube, powders (like starch, zinc oxide etc.). We can also set the temperature according to our requirements. It is also used for dehydrating the silica gel beads used in global migration.

Figure No: 02 Hot Air Oven

c) pH Meter

pH meter is an instrument which is used to measure the hydrogen ion concentration i.e., H^+ and OH^- based on the solution whether it is acids or a base. It is also known as "potentiometric pH meter" because it sometimes measures the difference between a pH. electrode and a reference electrode

Figure No: 03 pH Meter

d) Electronic analytical balance

Electronic balance is an instrument which is mainly used in laboratory and is used to weight the samples and chemicals (from microgram to gram, in decimals).

Figure No: 04 Electronic analytical balance

e) Muffle furnace

Muffle furnace is a type of oven which works under high temperature. And we can also set the temperature according to our requirements.

Figure No: 05 Muffle furnace

Figure No: 06 Muffle furnace

d) Hot Plate

Hot plate is an instrument which is mainly used in laboratory to heat samples. And it works under 100° temperature or even higher. This plate is made up of ceramic, aluminium or enamel. This device can be maintain & clean easily.

Figure No: 07 Hot Plate

f) UV-spectrophotometer

A spectrophotometer is an instrument that measures the number of photons (the intensity of light) passes through sample solution. Over a certain range of wavelength all chemicals compound absorbs, transmit or reflect light.

Figure No: 08 UV-Spectrophotometer

g) Atomic Absorption Spectrophotometer

Atomic Absorption Spectrophotometer (AAS) is a technique which is determining the concentration of metal elements in a given sample. It also helps in identifying different elements in solution. It is used in chemistry areas also like clinical analysis of metals in biological fluids & tissues such as plasma, urine, saliva, brain tissue, liver, hair, etc.

Figure No: 09 Atomic Absorption Spectrophotometer

4.2.3 Methodology

4.2.3.1 Cleaning of glassware's

The general mechanism for cleaning of glassware could be summarized as follows:

- Cleaning by detergent
- Cleaning by chromic acid

General procedure for cleaning of glassware's by detergent

Glassware

Washed with tap water

Washed with Detergent Solution

Washed With tap Water Keep glassware for Drying

Note Graduate glassware are air dried where non-graduate is dried in a hot air oven at 100°C.

4.2.3.2) Cleaning of glassware's by chromic acid

Chromic acid is a commonly used glassware cleaning reagent. It is prepared in 1 litter container by dissolving 5gm of potassium di-chromate in approximately 10ml of double distilled water and then slowly adding a total volume of one litter chromic acid solution. A series drawback to this solution is that is quite dangerous to use. Some technicians also complain that a film is often left behind on the glassware.

4.2.3.3) Preparation of 5% chromic acid

Take 5gm potassium di-chromate or sodium di-chromate in conical flask and add 10ml of double distilled water (1litter) with concentrated sulfuric acid in conical flask in ice box.

4.3) Methodology

4.3.1) Sample Collection

We collected the plastic food packaging sample from different palace of Jankipurum, sector- g, and collected bioplastic sample from Spencer's Store aliganj, Lucknow.

a. **Material Requirement**
   - Scissor
   - Calibrated scale
   - Food Packaging Sample (Plastic, bioplastic and Aluminum foil)
   - Marker

b. **Preparation of Sample**
   - Take a sample & mark it in 5*5 cm with the help of marker
   - After that cut the sample into 5×5 cm in per 100 ml simulant
   - After cutting the pieces washed it properly with distilled water

c. **Preparation of Leachates**
   - **Glassware**
     - Beaker
     - Measuring cylinder
     - Reagent bottle.
   - **Simulants**
     - Distilled water
     - Acetic acid (3%)

- NaCl (0.9%)

Table No 02 - Preparation of Stimulants

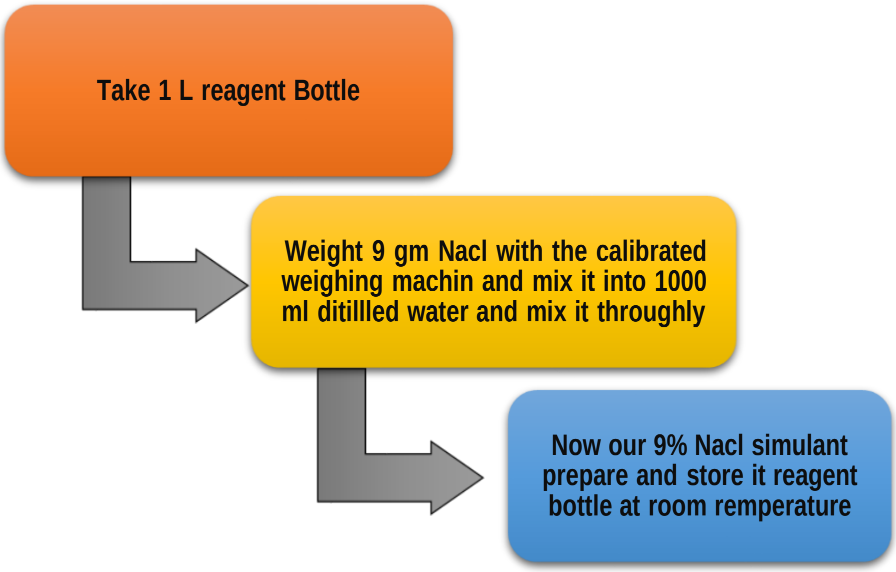
SNO	Stimulant Name	Volume required of reagent	Volume Required of distilled water	Total Volume
1	Distilled Water	_	1000 ml	1000 ml
2	Acetic acid (3%)	30 ml	970ml	1000ml
3	NaCl (9%)	9 gm	1000ml	1000ml

Table No 03: Different temperature Conditions

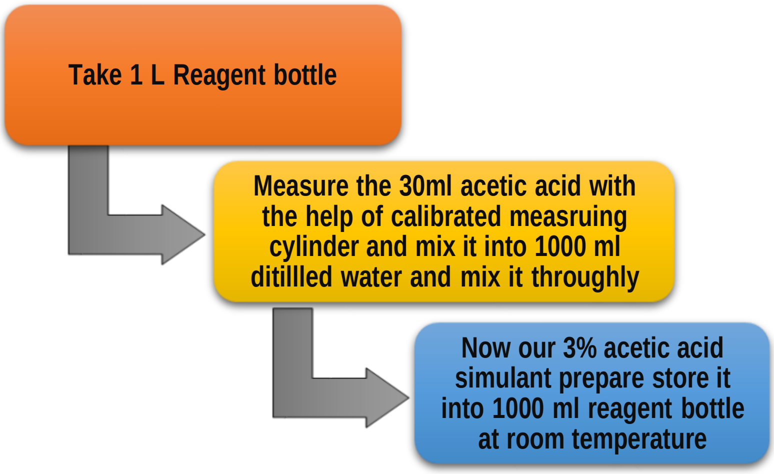
SNO	Stimulant Name	Temperature Condition
1	Distilled Water	40 ºC±2 for 24 hours 60ºC±2 for 2 hours
2	Acetic acid (3%)	40 ºC±2 for 24 hours 60ºC±2 for 2 hours
3	Nacl (9%)	40 ºC±2 for 24 hours 60ºC±2 for 2 hours

4.3.2) Procedure of Simulant Preparation

1. **9% Normal Saline Simulant preparation**



2. **3% Acetic Acid Simulant preparation**



3. **Distilled water simulant preparation**

   Distilled directly use as simulant. We took 1000 ml in 1000 ml reagent bottle at room temperature.

4.3.3 Procedure of Leachates

- **Glassware & Equipments**
- Beaker
- Measuring cylinder

- Aluminium Foil
- Hot air oven

For 40ºC

Take 4 250ml beaker and mark it 1,2,3,4 for each three simulants and packed it with aluminum

↓

foil

Take 2 pieces of each sample and put it in beaker 2,3,4 sample and 1 beaker use as a blank

↓

Incubate it in hot air oven 40ºC±2 for 24 hours

↓

Now leachates prepared for further experiment

For 60ºC

Take 4 250ml beaker and mark it 1,2,3,4 for each three simulants and packed it with aluminum

↓

foil

Take 2 pieces of each sample and put it in beaker 2,3,4 sample and 1 beaker use as a blank

↓

Incubate it in hot air oven 60ºC±2 for 2 hours

↓

Now leachates prepared for further experiment

4.4.4 Change in physical State

The leachate of each sample was examined for any change in physical state of leachate under simulated test conditions.

4.4.4.1 Estimation of Overall Migration

Glassware & Equipment

- Crucible
- Muffle furnace
- Hot plate etc.

Reagents

Leachate solutions (extract)

Procedure

Crucible constant in muffle furnace at 2 hours at 500°C

↓

Now putout the crucible after constant

↓

then take empty crucible weight

↓

Now take a 50ml leachate sample (extract) in per crucible

↓

Now digest the sample in the hot plate After digestion weighing the crucible

↓

Now calculate the values

Note: These procedures were fellow for each packaging sample.

4.4.4.2Estimation of UV-Absorbing Material

Sample & Equipment

- Leachate sample (extract)
- Test tube
- UV spectrophotometer
- Cuvette

Procedure

Turn on the UV spectrophotometer and allow the lamps to warm up for an appropriate period of time to stabilize them there are two cuvettes in spectrophotometer 1 for sample and 2^{nd} for blank

↓

Now take reading of distilled water and set as a blank

↓

After that take 3 ml sample in cuvette and took a reading on spectrophotometer at 200-400nm

4.4.4.3 Estimation of Heavy Metal

Requirements

- leachate sample (extract)
- conical flask
- Nitric acid
- Perchloric acid
- Fume hood

- Deionized water
- Atomic absorption spectrophotometer

Procedure

5:1 solution of Nitric Acid and perchloric acid

↓

Take 25 ml Conical Flasks Add: 2ml sample + 20 ml distilled water

↓

Digest the sample on hotplate until 1-2 ml sample remain and then 20 ml volume make up by distilled water after this transfer 10 ml sample in fallopian tubes

↓

Take a reading on atomic absorption spectroscopy

5. Results and Discussion

5.1 Sample Collection

Figure- 10 A (sample BV/22/1.0)

Figure- 11 B (Sample BV/22/2.0)

Figure- 12 C (Sample BV/22/2.1)

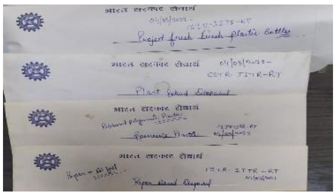


Figure- 13 D (Envelops ofSamples)

5.2 Physicochemical analysis of food packaging material sample BV/22/1.0

5.2.1Change in Physical State in Distilled Water

Table No 04: Change in physical State in model simulant distilled water at 40°C±2 and 60°C±2

SNO	Test and Requirements	Observation	Remark
		At 40ºC±2	
1	Physical state of material (Requirement: No Changes)	**No changes**	OK
2	Smell (requirements: odourless)		OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK
		At 60ºC±2	
1	Physical state of material (Requirement: No Changes)	**No Changes**	OK
2	Smell (requirements: odourless)		OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK

Remarks: No Physical Changes Observed

5.2.2Change in Physical State in 3 % Acetic Acid

Table No 05: change in physical State in model simulant acetic acid (3%) at 40°C±2 and60°C±2

SNO	Test and Requirements	Observation	Remark
	At 40°C±2		
1	Physical state of material (Requirement: No Changes)		OK
2	Smell (requirements: odourless)	**No changes**	OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK
	At 60°C±2		
1	Physical state of material (Requirement: No Changes)		OK
2	Smell (requirements: odourless)	**No Changes**	OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK

Remarks: No Physical Changes Observe

5.2.3. Change in Physical State in 0.9% Normal Saline

Table No 06: change in physical State in model simulant acetic acid (3%) at 40°C±2 and 60°C±2

SNO	Test and Requirements	Observation	Remarks, if any
	At 40°C±2		
1	Physical state of material (Requirement: No Changes)		OK
2	Smell (requirements: odourless)	**No changes**	OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK
	At 60°C±2		
1	Physical state of material (Requirement: No Changes)		OK
2	Smell (requirements: odourless)	**No Changes**	OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK

Remarks: No Physical changes observed

Physicochemical analysis of food packaging material sample BV/22/2.0

5.2.4 Change in Physical State in biobased polymer (Bioplastic) in Distilled Water

Table No 07 Change in physical State in model simulant distilled water at 40°C±2 and 60°C±2

SNO	Test and Requirements	Observation	Remark
At 40ºC±2			
1	Physical state of material (Requirement: No Changes)	**No changes**	OK
2	Smell (requirements: odourless)		OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK
At 60ºC±2			
1	Physical state of material (Requirement: No Changes)	**No Changes**	OK
2	Smell (requirements: odourless)		OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK

Remarks: No Physical changes observed

5.3.5 Change in Physical State in Biobased Polymer in Acetic Acid (3%)

Table No08: change in physical State in model simulant acetic acid (3%) at 40°C±2 and 60°C±2

SNO	Test and Requirements	Observation	Remark
At 40ºC±2			
1	Physical state of material (Requirement: No Changes)	**No changes**	OK
2	Smell (requirements: odourless)		OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK
At 60ºC±2			
1	Physical state of material (Requirement: No Changes)	**No Changes**	OK
2	Smell (requirements: odourless)		OK

3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK

Remarks: No physical Changes Observed

Change in Physical State in Biobased Polymer (Bioplastic) in0.9% Norma Saline

Table No 09: change in physical State in model simulant Normal Saline (0.9%) at 40°C±2 and 60°C±2

SNO	Test and Requirements	Observation	Remark
		At 40ºC±2	
1	Physical state of material (Requirement: No Changes)	**No changes**	OK
2	Smell (requirements: odourless)		OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK
		At 60ºC±2	
1	Physical state of material (Requirement: No Changes)	**No Changes**	OK
2	Smell (requirements: odourless)		OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)		OK

Remarks: No Physical changes observed

Physicochemical analysis of food packaging material sample BV/22/2.1 (Biobased polymer paper disposal)

5.3.7 Change in Physical State in Biobased Polymer in Distilled Water

Table No 10: change in physical State in model simulant distilled water at40°C±2 and 60°C±2

SNO	Test and Requirements	Observation	Remark
		At 40ºC±2	
1	Physical state of material (Requirement: No Changes)	Slightly Change	Yes
2	Smell (requirements: odourless)	No	OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)	No	OK
		At 60ºC±2	
1	Physical state of material (Requirement: No Changes)	No	Yes
2	Smell (requirements: odourless)	NO	OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)	NO	OK

Remarks: Slightly Changes Observed

5.3.6 Change in physical state in Biobased Polymer in 3% acetic acid

S. No	Sample	Simulants	Physical State	Odour	Colour
		For 40 ºC ±2			
1	**BV/22/1.0**	**Distilled Water**	OK	OK	OK
		Acetic Acid (3%)	OK	OK	OK
		Normal Saline (9%)	OK	OK	OK
2	**BV/22/2.0**	**Distilled Water**	OK	OK	OK
		Acetic Acid (3%)	OK	OK	OK
		Normal Saline (9%)	OK	OK	OK
3	**BV/22/2.1**	**Distilled Water**	Slightly Change	OK	OK
		Acetic Acid (3%)	OK	OK	OK
		Normal Saline (9%)	Slightly Change	OK	OK

Table No 11: change in physical State in model simulant acetic acid (3%) at 40°C±2 and60°C±2

Remarks: No Physical Changes Observed

5.3.7 Change In physical state in Biobased Polymer (paper disposal) in 9% Normal

Table No 12: change in physical State in model simulant normal saline 40°C±2 and60°C±2

SNO	Test and Requirements	Observation	Remark
For 40°C±2			
1	Physical state of material (Requirement: No Changes)	Slightly Change	Yes
2	Smell (requirements: odourless)	No	OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)	No	OK
For 60°C±2			
1	Physical state of material (Requirement: No Changes)	No	Yes
2	Smell (requirements: odourless)	NO	OK
3	Clarity and color of leachate (Requirement: color of leachate should be clear and colourless)	NO	OK

Remarks: Slightly Changes Observed

5.3.8 Comparison Between Petroleum Based and Biobased Packaging Material

Table No 13: Comparison Between Petroleum and Biobased Packaging Material at temperature 40°C±2

S. No	Sample	Simulants	Physical State	Odour	Colour
For 40 ºC ±2					
1	**BV/22/1.0**	**Distilled Water**	OK	OK	OK
		Acetic Acid (3%)	OK	OK	OK
		Normal Saline (9%)	OK	OK	OK
2	**BV/22/2.0**	**Distilled Water**	OK	OK	OK
		Acetic Acid (3%)	OK	OK	OK
		Normal Saline (9%)	OK	OK	OK
3	**BV/22/2.1**	**Distilled Water**	Slightly Change	OK	OK
		Acetic Acid (3%)	OK	OK	OK

		Normal Saline (9%)	Slightly Change	OK	OK

This table shows the comparison between changes in physical state in petroleum and biobasedpackaging material the given data of given table, it was concluded that, there were no physical changes in sample BV/22/1.1 and BV/22/1.2 and in sample BV/22/2.2, slightly observed at 40°C±2.

Table No 14: Comparison Between Petroleum and Biobased Packaging Material attemperature 60°C±2

S. No	**Sample**	**Simulants**	**Physical State**	**Odour**	**Colour**
For 60 ºC ±2					
1	**BV/22/1.0**	**Distilled Water**	OK	OK	OK
		Acetic Acid (3%)	OK	OK	OK
		Normal Saline (0.9%)	OK	OK	OK
2	**BV/22/2.0**	**Distilled Water**	OK	OK	OK
		Acetic Acid (3%)	OK	OK	OK
		Normal Saline (9%)	OK	OK	OK
3	**BV/22/2.1**	**Distilled Water**	OK	OK	OK
		Acetic Acid (3%)	OK	OK	OK
		Normal Saline (0.9%)	OK	OK	OK

This table shows the comparison between changes in physical state in petroleum and biobased packaging material. By the given data of given table, it was concluded that, there were no physical changes in sample BV/22/1.1, BV/22/1.2 and BV/22/2.2 observed.

Figure no- 14 Sample (BV/22/1.0)

Figure No- 15 Sample (BV/22/2.0)

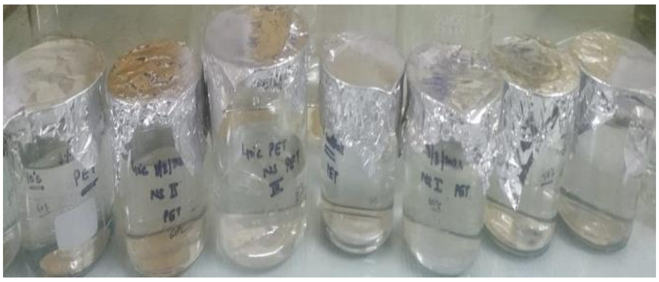


Figure no- 16 Sample (BV/22/2.1)

6.0 Result of Global/Overall Migration

(Figure No:1 7 Sample: BV/22/1.0

(Figure No; 18 Sample: BV/22/2.0)

Figure No :19 Sample:BV/22/2.1

6.1Estimated Result of Global Migration in Petroleum Based Packaging Material

6.1.1 Estimation of Overall Global Migration in Biobased polymeric compoundBioplastic

Table No15: Result of Global Migration of Petroleum based Packaging Material in model simulant at 40°C±2 and 60°C±2

S. No	**Stimulant(s) and Packaging Material**	**Final Result**	**Remarks**
	PET Plastic		
	Temperature 40ºC±2		
1	Distilled Water	0.24	OK
2	Acetic Acid	0.009	OK
3	Normal Saline	0.19	OK
Temperature 60 ºC±2			
1	Distilled Water	0	OK
2	Acetic Acid	0.08	OK
3	Normal Saline	0.02	OK

Result: Global /overall migration in sample BV/22/1.1 was found below the permissible limits.

Remarks: Permissible limit: 5 mg/100 ml

Table No16: Result of Global Migration of Biobased Packaging Material in model simulant at 40°C±2 and 60°C±2

(Sample BV/22/2.0)

S. No	**Simulant(s)**	**Packaging Material**	**Final Result**	**Remarks**
Temperature 40ºC±2				

1	Distilled Water	0.003	OK
2	Acetic Acid	0.013	OK
3	Normal Saline	0.02	OK
Temperature 60 ºC±2			
1	Distilled Water	0.003	OK
2	Acetic Acid	0.001	OK
3	Normal Saline	0.36	OK

Result: Global /overall migration in sample BV/22/1.1 was found below the permissible limits.

Remarks: Permissible limit: 5 mg/100 ml

Estimation of Overall Global Migration in Biobased polymeric compound

Table No 17: Result of Global Migration of Biobased based Packaging Material in modelsimulant at 40°C±2 and 60°C±2

Sample (BV/22/2.0)

S. No	Simulant(s)	Packaging Material	Final Result	Remarks
Biobased Polymer [Paper Disposal] Temperature 40ºC±2				
1	Distilled Water		0.09	OK
2	Acetic Acid (3%)		0.04	OK
3	Normal Saline (9%)		0.39	OK
	Temperature 60 ºC±2			
1	Distilled Water		0.00	OK
2	Acetic Acid (3%)		0.00	OK
3	Normal Saline (9%)		0.47	OK

Global /overall migration in sample BV/22/1.1 was found below the permissible limits.

The overall migration at 40±2 C for 24 hours and 60±2 C for 2 hours was estimated in the leachate of plastic and biobased polymers. We can get the overall migration of materials to be below the limit of detection.

6.0 Estimation of Heavy Metal

Estimation of Heavy Metal in PET plastic & Biobased Polymer in Normal Saline

Table No18: Estimated result of heavy metal in Distilled Water in BV/22/1.0 Plastic andBV/22/2.0, BV/22/2.1

For Distilled water

S. No	Simulants	Heavy Metal	Estimated Result		Remarks
	BV/22/1.0				
	Temperature 60ºC± 2				
	Distilled Water				
			Control	**Sample**	
	1	Cr	0.916	0.796	OK
	2	Pb	0.225	0.108	OK
	3	Ni	0.094	0.094	OK
	4	Fe	6.175	3.977	Exceed the Permeable Limits
	5	Zn	0.344	0.108	OK
Biobased Polymer Temperature 60ºC ± 2					
	1	Cr	0.0544	-0.0151	OK
	2	Pb	0.321	0.158	OK
	3	Ni	0.055	0.127	OK
	4	Fe	0.513	1.338	Exceed the Permeable Limits
	5	Zn	0.081	0.111	OK

Table No 19: Estimated result of heavy metal in Normal Saline (0.9%) in BV/22/1.0, BV/22/2.0and BV/22/2.1

S. No	Simulants	Heavy Metal	Estimated Result	Remarks
	PET Plastic			

	Temperature 60ºC± 2				
	Normal Saline				
			Control	**Sample**	
	1	Cr	-0.00060	0.0207	OK
	2	Pb	-0.040	0.224	OK
	3	Ni	0.062	0.125	OK
	4	Fe	0.436	0.753	OK
	5	Zn	0.158	0.321	OK
Paper Based Disposal Temperature 0ºC ± 2					
	1	Cr	-0.0814	-0.0904	OK
	2	Pb	0.153	0.076	OK
	3	Ni	0.105	0.109	OK
	4	Fe	0.436	0.753	OK
	5	Zn	0.234	0.081	OK

Table No20: Estimated result of heavy metal in Acetic Acid (3%) in BV/22/1.0,BV/22/2.0 and

S. No	**Simulants**	**Heavy Metal**	**Estimated Result**		**Remarks**
1	**PET Plastic**				
	Temperature 60ºC± 2				
	Acetic Acid (3%)				
			Control	**Sample**	
	1	Cr	-0.0837	-0.0679	OK
	2	Pb	0.093	0.285	OK
	3	Ni	0.079	0.081	OK

BV/22/2.1

	4	Fe	0.711	0.578	OK
	5	Zn	0.293	0.339	OK
Paper Based Disposal Temperature 60ºC ± 2					
	1	Cr	-0.0343	-0.0859	OK
	2	Pb	0.267	0.197	OK
	3	Ni	0.091	0.106	OK
	4	Fe	1.473	1.338	OK
	5	Zn	0.293	0.339	OK

The migration of Heavy metal in Packaging material at 60°C±2 for 2 hours for 2 hours was estimated inleachate of packaging material. In the above tables it was concluded that the migration of heavy metals were below the permissible limits.

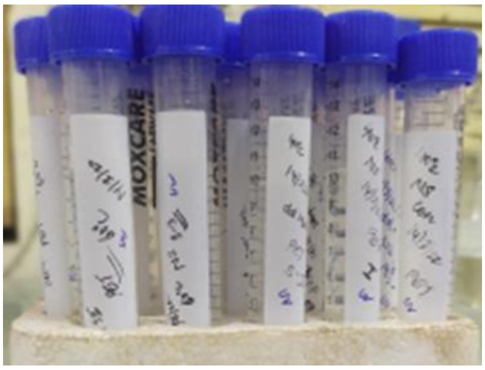


Figure No: 20 Heavy Metal Sample

7. Result of UV-Absorbing Material:

Table No 21: Optical Density UV-Absorbing compounds in BV/22/1.0 BV/22/2.0 and BV/22/2.1

SNO	WR (200-400)	UV-Absorbance											
		Distilled Water				3%Acetic acid				9% Normal saline			
		C	S1	S2	S3	C	S1	S2	S3	C	S1	S2	S3
[Sample 01-CSIR/IITR/001] At 40ºC±2													
A	200	0.664	0.153	0.110	0.008	0.623	0.690	0.662	0.694	0.361	0.028	0.027	0.029
B	225	0.008	0.001	0.010	0.010	0.149	0.018	0.172	0.183	0.009	0.008	0.002	0.002
C	250	0.001	0.000	0.002	0.003	0.011	0.011	0.013	0.012	0.005	0.004	0.002	0.001
D	275	0.006	0.003	0.005	0.007	0.010	0.012	0.013	0.012	0.006	0.005	0.003	0.003
E	300	0.004	0.002	0.004	0.006	0.000	0.009	0.011	0.010	0.004	0.004	0.003	0.002
F	325	0.001	0.001	0.000	0.002	0.005	0.005	0.005	0.005	0.001	0.001	0.004	0.001
G	350	0.001	0.000	0.000	0.002	0.000	0.005	0.006	0.005	0.001	0.000	0.003	0.001
H	375	0.000	0.002	0.000	0.002	0.005	0.005	0.005	0.004	0.001	0.000	0.001	0.001
I	400	0.000	0.002	0.001	0.002	0.003	0.003	0.004	0.004	0.000	0.000	0.000	0.002
[Sample 01-CSIR/IITR/001] At 60ºC±2													
A	200	0.092	0.037	0.476	0.067	0.210	0.240	0.169	0.157	0.284	0.324	0.339	0.239

B	225	0.004	-0.005	0.081	0.004	0.497	0.509	0.191	0.487	-0.009	-0.006	-0.008	-0.008
C	250	0.003	-0.003	0.001	-0.002	0.024	0.024	0.019	0.026	-0.002	-0.003	0.001	0.001
D	275	-0.008	-0.004	-0.004	-0.003	0.007	0.009	0.005	0.025	-0.010	-0.011	-0.004	-0.004
E	300	-0.007	-0.003	-0.005	0.000	0.009	0.010	0.006	0.010	-0.009	-0.012	-0.006	-0.006
F	325	-0.003	-0.002	-0.001	-0.001	0.007	0.008	0.005	0.007	-0.010	-0.011	-0.005	-0.005
G	350	-0.003	-0.001	-0.001	0.001	0.008	0.009	0.005	0.009	-0.010	-0.012	-0.006	-0.006
H	375	-0.003	0.000	-0.001	0.001	0.008	0.010	0.006	0.010	-0.010	-0.011	-0.007	-0.007
I	400	-0.003	0.000	-0.001	0.000	0.008	0.010	0.005	0.009	-0.010	-0.011	-0.008	-0.007

[Sample 02 CSIR/IITR/002]
At 40ºC±2

A	200	0.989	0.049	0.038	0.030	0.310	0.210	0.200	0.019	0.345	0.024	0.020	0.015
B	225	0.009	-0.007	-0.006	-0.005	0.048	0.409	0.013	0.012	-0.008	-0.004	-0.012	-0.009
C	250	0.008	-0.005	-0.007	-0.004	0.010	0.034	0.040	0.23	-0.007	-0.006	-0.012	0.001
D	300	0.004	-0.003	-0.009	-0.003	0.007	0.005	0.008	0.007	-0.005	-0.007	-0.000	0.001
E	325	-0.003	-0.003	-0.005	-0.002	0.008	0.005	0.008	0.008	-0.010	-0.009	-0.006	0.001
F	350	-0.002	-0.001	-0.003	-0.002	0.007	0.003	0.007	0.008	-0.004	-0.009	-0.001	-0.007
G	375	-0.002	-0.001	-0.002	0.001	0.005	0.003	0.007	0.009	-0.005	-0.002	-0.001	-0.007
I	400	-0.001	0.000	-0.001	0.001	0.005	0.003	0.001	0.000	-0.005	-0.002	-0.001	-0.008

[Sample 02 CSIR/IITR/002]
At 60ºC±2

A	200	0.903	0135	0153	0.056	0.161	0.161	0.164	0.178	0.333	0.360	0.341	0.412
B	225	0.666	0.031	0.058	-0.012	2.905	0.403	0.443	0.490	-0.013	0.012	0.020	0.020
C	250	0.018	0.036	0.061	0.004	-0.008	0.025	0.27	0.028	-0.025	-0.001	0.032	0.031
D	275	0.023	0.013	0.034	-0.014	-0.026	-0.022	-0.024	-0.026	-0.027	-0.002	0.010	0.006
E	300	-0.018	0.009	0.028	-0.015	-0.023	-0.021	-0.022	-0.025	-0.022	-0.000	0.009	0.005
F	325	-0.018	0.008	0.026	-0.012	-0.019	-0.013	-0.021	0.023	-0.018	0.000	0.013	0.003
G	350	-0.010	0.013	0.029	-0.005	-0.011	-0.013	-0.014	-0.016	-0.010	0.005	0.015	0.009
H	375	-0.007	0.013	0.029	-0.002	0.008	-0.011	-0.011	-0.012	-0.007	0.007	0.015	0.010
I	400	-0.005	0.013	0.028	-0.000	-0.006	-0.008	-0.009	-0.010	-0.005	0.008	0.012	0.010

[Sample 03 CSIR/IITR/003]
At 40ºC±2

A	200	-0.027	0.556	0.442	0.458	0.019	0.228	0.119	0.004	0.223	0.229	0.222	0.234
B	225	-0.015	0.222	0.267	0.145	0.015	0.098	0.068	0.060	0.198	0.039	0.035	0.036
C	250	-0.009	0.090	0.010	0.014	0.008	0.078	0.056	0.046	-0.222	0.030	0.034	0.038
D	275	-0.008	0.078	0.056	0.045	0.002	0.027	0.035	0.030	-0.019	0.020	0.019	0.016
E	300	-0.007	0.060	0.034	0.020	-0.000	0.020	0.017	0.012	-0.015	0.015	0.019	0.013
F	325	-0.006	0.017	0.015	0.014	-0.001	0.015	0.015	0.013	-0.014	0.013	0.010	0.011
G	350	-0.005	0.013	0.011	0.009	-0.002	0.001	-0.001	0.004	-0.013	0.011	0.010	0.003
H	375	-0.002	0.010	0.005	0.009	-0.003	-0.008	-0.005	-0.003	-0.012	0.004	0.005	0.003
I	400	-0.003	0.009	0.002	0.008	-0.004	-0.006	-0.003	-0.001	-0.011	0.003	0.002	0.001

[Sample 03 CSIR/IITR/003]
At 60ºC±2

A	200	-0.014	0.663	0.320	0.1449	0.097	0.663	0.320	0.499	0.249	0.276	0.722	0.765
B	225	-0.031	0.223	0.110	0.364	0.008	0.223	0.110	0.364	0.004	0.216	0.231	0.235
C	250	-0.025	0.099	0.046	0.070	-0.012	0.099	0.046	0.070	-0.009	0.102	0.090	0.094
D	275	-0.025	0.090	0.048	0.064	-0.011	0.092	0.048	0.067	-0.011	0.090	0.079	0.042

E	300	-0.023	0.050	0.021	0.034	-0.010	0.050	0.021	0.034	-0.010	0.051	0.041	0.028
F	325	-0.018	0.034	0.014	0.008	-0.009	0.034	0.014	0.008	-0.010	0.037	0.029	0.013
G	350	-0.018	0.018	0.005	0.002	-0.009	0.018	0.005	-0.002	-0.011	0.022	0.014	-0.000
I	375	-0.017	0.008	-0.003	0.002	-0.010	0.008	-0.003	-0.002	-0.011	0.011	0.001	-0.000
J	400	-0.017	0.001	-0.007	0.006	-0.009	0.001	-0.007	-0.006	-0.010	0.005	-0.006	-0.000

7.1 Estimation of UV-absorbing Material

Table No22: Average Means Optical Density of UV-Absorbing Material for Sample BV/22/1.0

Wavelength	Distilled water	Acetic Acid (3%)	Normal Saline (0.9%)	Remarks
BV/22/1.040°C±2				
200	0.573	-0.059	0.333	OK
225	0.001	0.024	0.005	OK
250	-0.000	-0.001	0.002	OK
275	0.001	-0.002	0.002	OK
300	0.000	-0.01	0.001	OK
325	0.000	0.000	-0.001	OK
350	0.000	-0.005	0.000	OK
375	0.001	0.000	0.000	OK
400	0.001	-0.000	0.000	OK

Wavelength	Distilled water	Acetic Acid (3%)	Normal Saline (0.9%)	Remarks
BV/22/1.060°C±2				
200	-0.101	0.021	-0.016	OK
225	-0.022	0.101	-0.001	OK

250	0.004	0.001	0.001	OK
275	0.004	-0.006	0.003	OK
300	0.004	-0.000	-0.001	OK
325	0.001	0.000	-0.003	OK
350	0.002	-0.000	0.002	OK
375	0.003	0.000	0.001	OK
400	0.002	-0.000	0.001	OK

Table No23 : Average Means Optical Density of UV-Absorbing Material for Sample BV/22/2.0

Wavelength	Distilled water	Acetic Acid (3%)	Normal Saline (0.9%)	Remarks
BV/22/2.0 40°C±2				
200	0.009	0.167	-0.325	OK
225	0.015	-0.096	-0.000	OK
250	0.013	0.009	0.001	OK
275	0.009	0.000	-0.003	OK
300	0.000	0.001	-0.005	OK
325	0.000	0.001	-0.003	OK
350	0.001	-0.003	0.001	OK
375	-0.001	0.003	0.001	OK
400	0.000	-0.000	-0.038	OK

Wavelength	Distilled water	Acetic Acid (3%)	Normal Saline (0.9%)	Remarks
BV/22/2.0 60°C±2				
200	0.001	0.006	-0.030	OK

225	-0.015	-0.011	-0.045	OK
250	0.012	0.002	-0.031	OK
275	-0.025	0.000	-0.026	OK
300	0.025	0.015	-0.025	OK
325	-0.022	0.003	-0.019	OK
350	-0.020	-0.019	-0.017	OK
375	-0.018	0.003	-0.015	OK
400	0.000	-0.003	0.000	OK

Table No24: Average Means Optical Density of UV-Absorbing Material for Sample BV/22/2.1

Wavelength	Distilled water	Acetic Acid (3%)	0Normal Saline (0.9%)	Remarks
BV/22/2.1 40°C±2				
200	-0.226	0.000	0.003	OK
225	-0.096	-0.052	-0.256	OK
250	-0.092	-0.002	-0.037	OK
275	-0.058	-0.016	-0.030	OK
300	-0.036	-0.015	-0.025	OK
325	-0.026	-0.003	-0.021	OK
350	-0.01	-0.019	-0.016	OK
375	-0.009	-0.002	-0.013	OK
400	0.389	0.000	0.000	OK

BV/22/2.0 **60°C±2**				
200	-0.263	-2.224	0.036	OK
225	-0.009	-0.083	0.038	OK
250	0.092	-0.008	0.016	OK
275	-0.058	-0.045	0.013	OK
300	0.036	-0.027	0/011	OK
325	-0.002	-0.016	0030	OK
350	-0.019	-0.005	0.003	OK
375	-0.017	-0.005	0.001	OK
400	0.000	0.000	0.000	OK

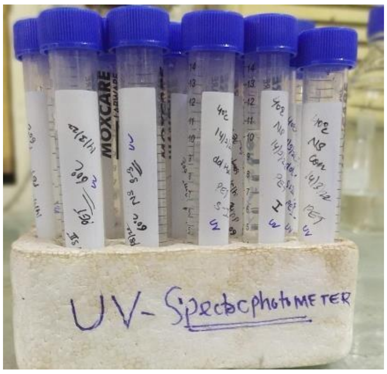


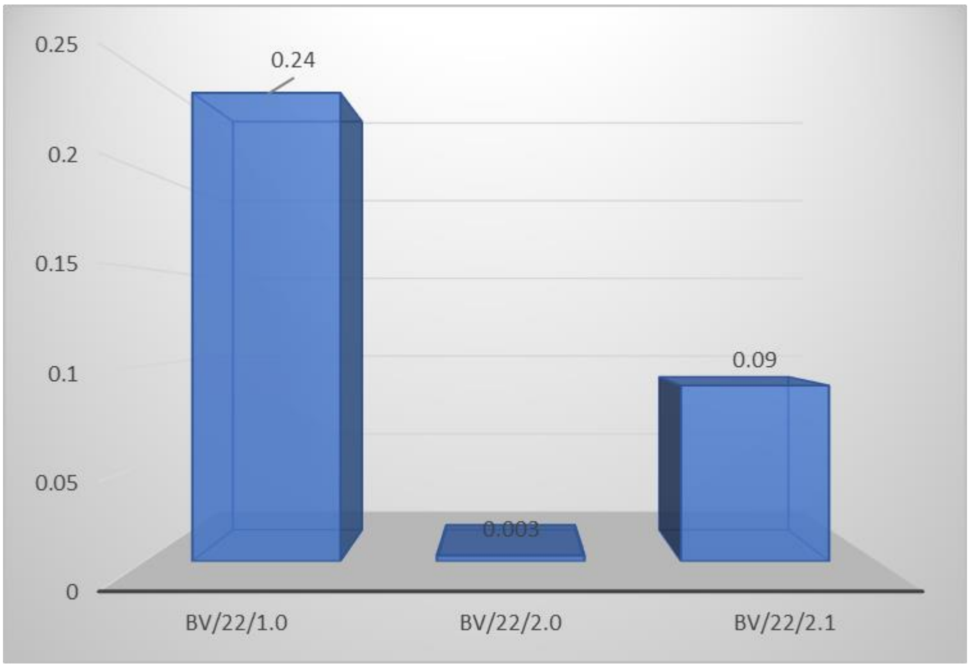
Figure No 21: UV Absorbing Material Samples

The migration of UV absorbing at 40°C±2 for 24 hours and 60°C±2 for 2 hours was estimated in leachate of packaging material. As evident from the above tables. We concluded that the migration of UV absorbing material was below the limit of detection.

Remarks:

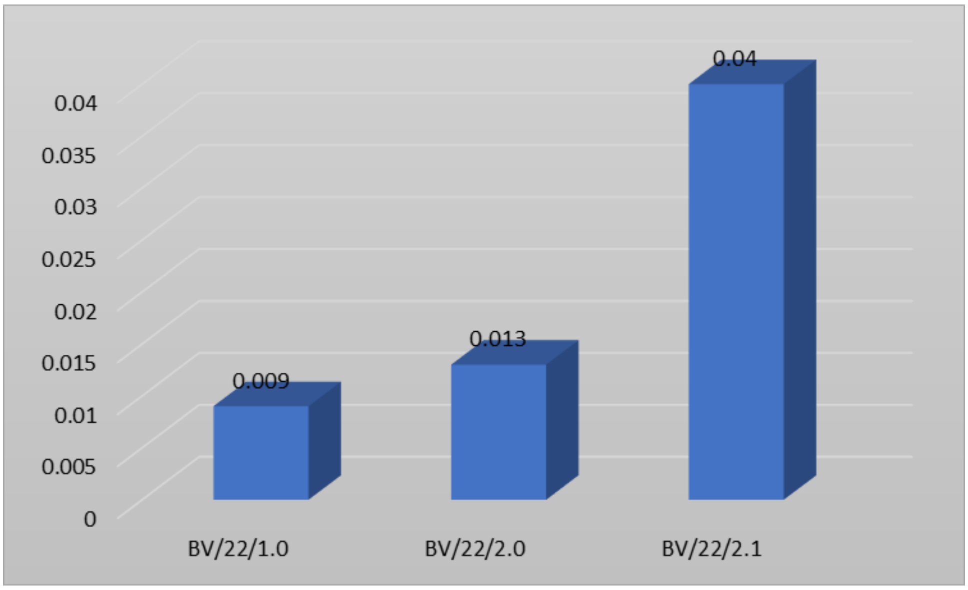
Detection Limit- 0.3 (200-400nm)

Estimation of Global Migration



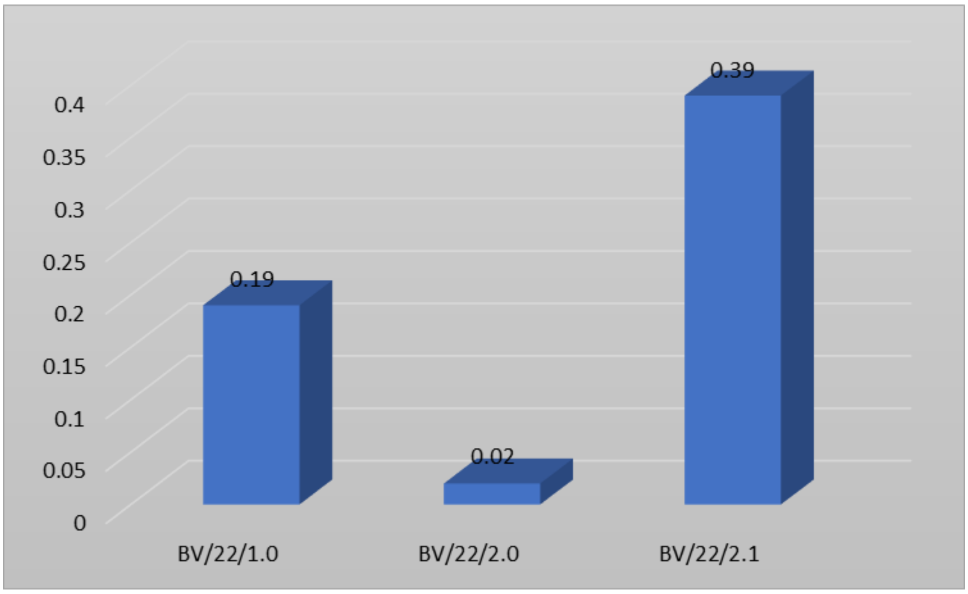
Graph 01: Overall Migration in BV/22/1.0, BV/22/2.0 and BV/22/2.1 andBiobased polymer at 40°C±2 for model simulant Distilled water

This Graph represent that overall/ global migration in both petroleum and biobased packaging material in model simulant distilled water at 40°C±2 and by the help of this graph it was conclude that overall/ global migration in sample BV/22/1.1 than the other two sample.



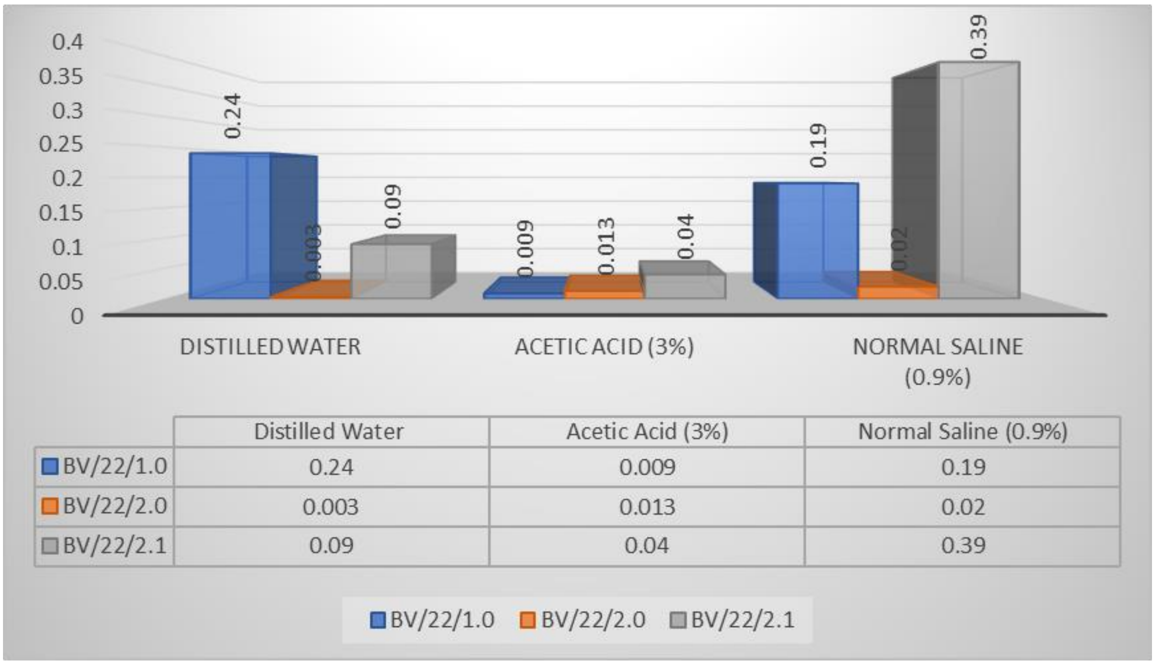
Graph 02: Overall Migration in BV/22/1.0, BV/22/2.0 and BV/22/2.1 at 40°C±2 for modelsimulant Acetic Acid (3%)

This Graph represent that overall/ global migration in both petroleum and biobased packaging material in model simulant acetic acid (3%) at 40°C±2 and by the help of this graph it was conclude that overall/global migration in sample BV/22/2.1 than the other two sample.



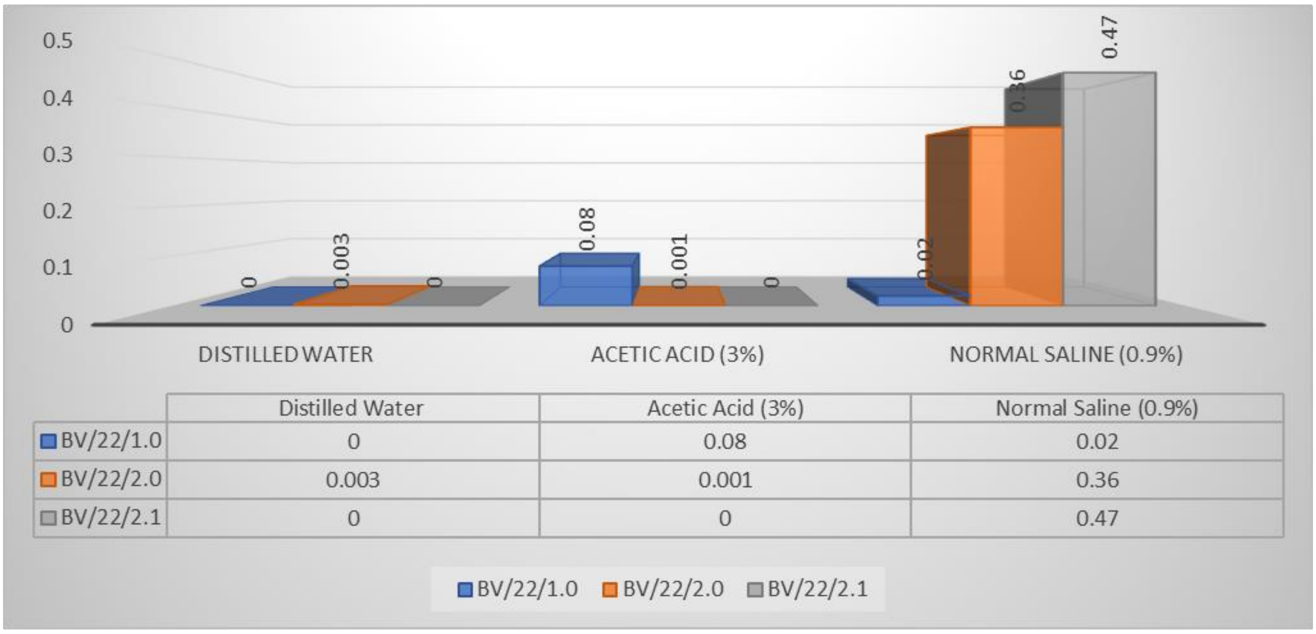
Graph 03: Overall Migration in BV/22/1.0, BV/22/2.0 and BV/22/2.1 at 40°C±2 for model simulant Normal Saline (9%)

This Graph represent that overall/ global migration in both petroleum and biobased packaging material biobased packaging materialin model simulant normal saline(0.9%) at 40°C±2 and by the help of this graph it was conclude that overall/ global migration in sample BV/22/2.1 than the other two sample.



Graph 04: Comparison Between Estimated Result of Global Migration in Model Simulant Distilled water, Acetic Acid (3%) and Normal Saline (9%) for 40°C±2

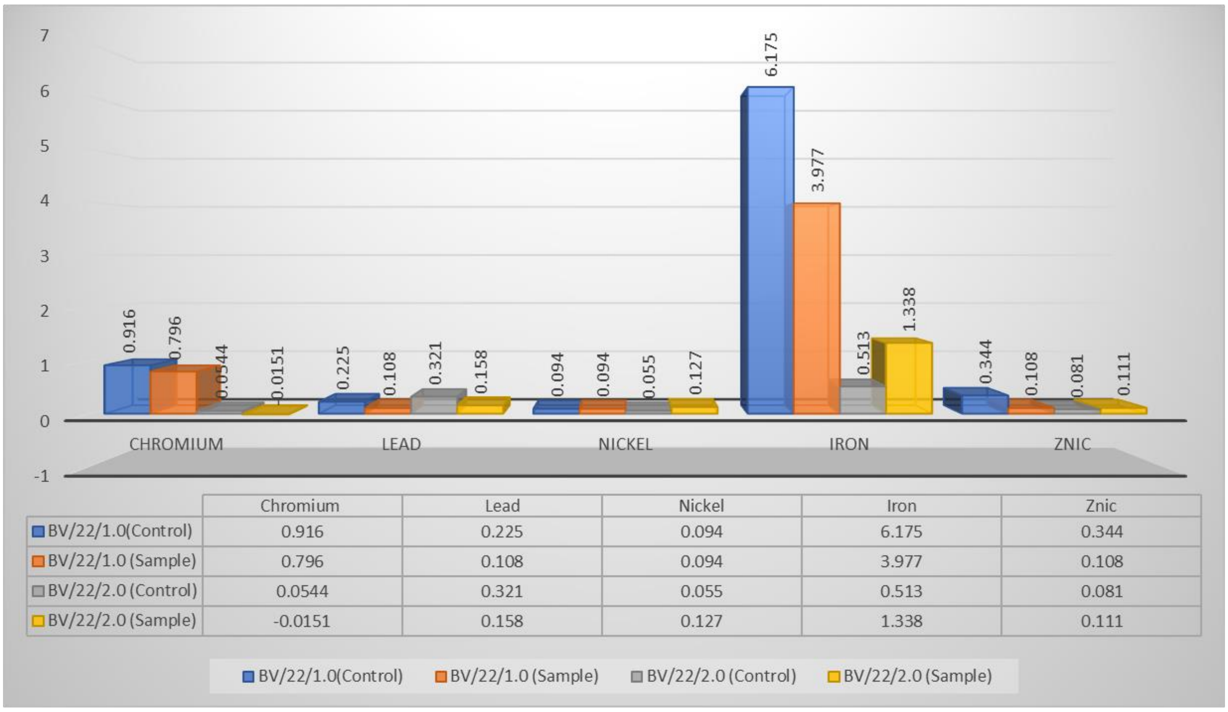
This Graph shows the Comparison Between Estimated Result of Global Migration in Model Simulant Distilled water, Acetic Acid (3%) and Normal Saline (9%) for 40°C±2.It was concluded that sample BV/22/2.0 is more acceptable than the two other sample.



Graph 05: Comparison Between Estimated Result of Global Migration in Model Simulant Distilled water,
Acetic Acid (3%) and Normal Saline (9%) for 60°C±2

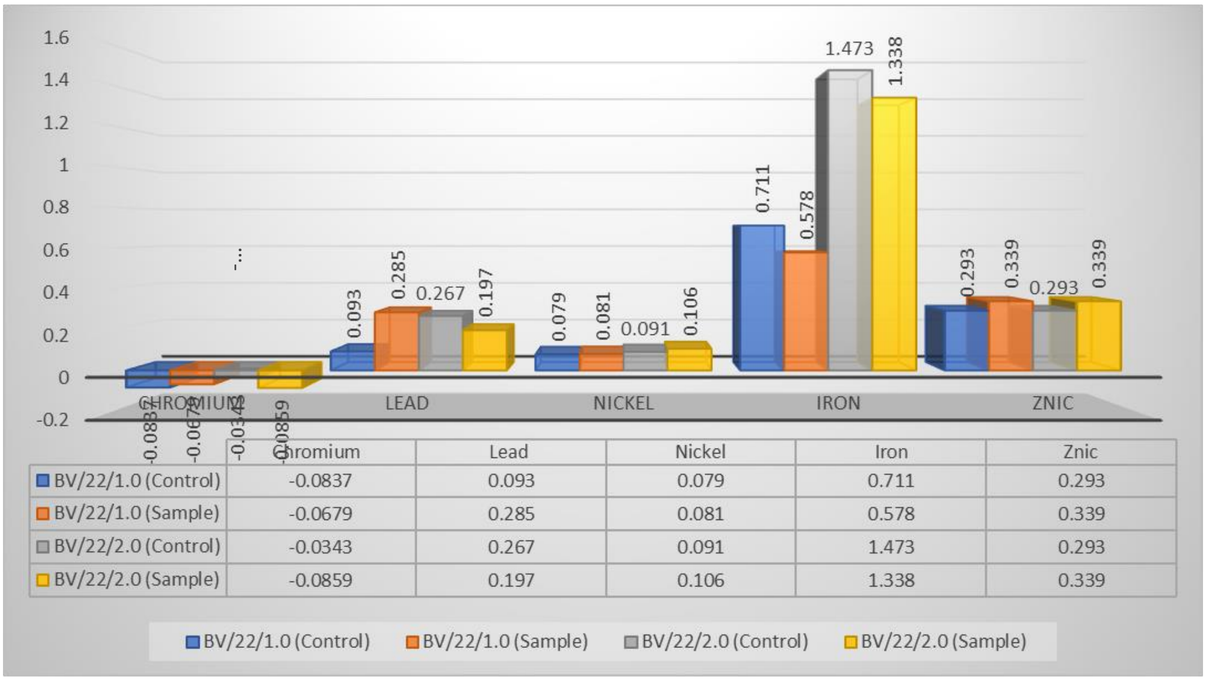
This Graph shows the Comparison Between Estimated Result of Global Migration in Model Simulant Distilled water, Acetic Acid (3%) and Normal Saline (9%) for 60°C±2.It was concluded that sample BV/22/2.0 is more acceptable than the two other sample.

Estimated Result for Heavy Metal



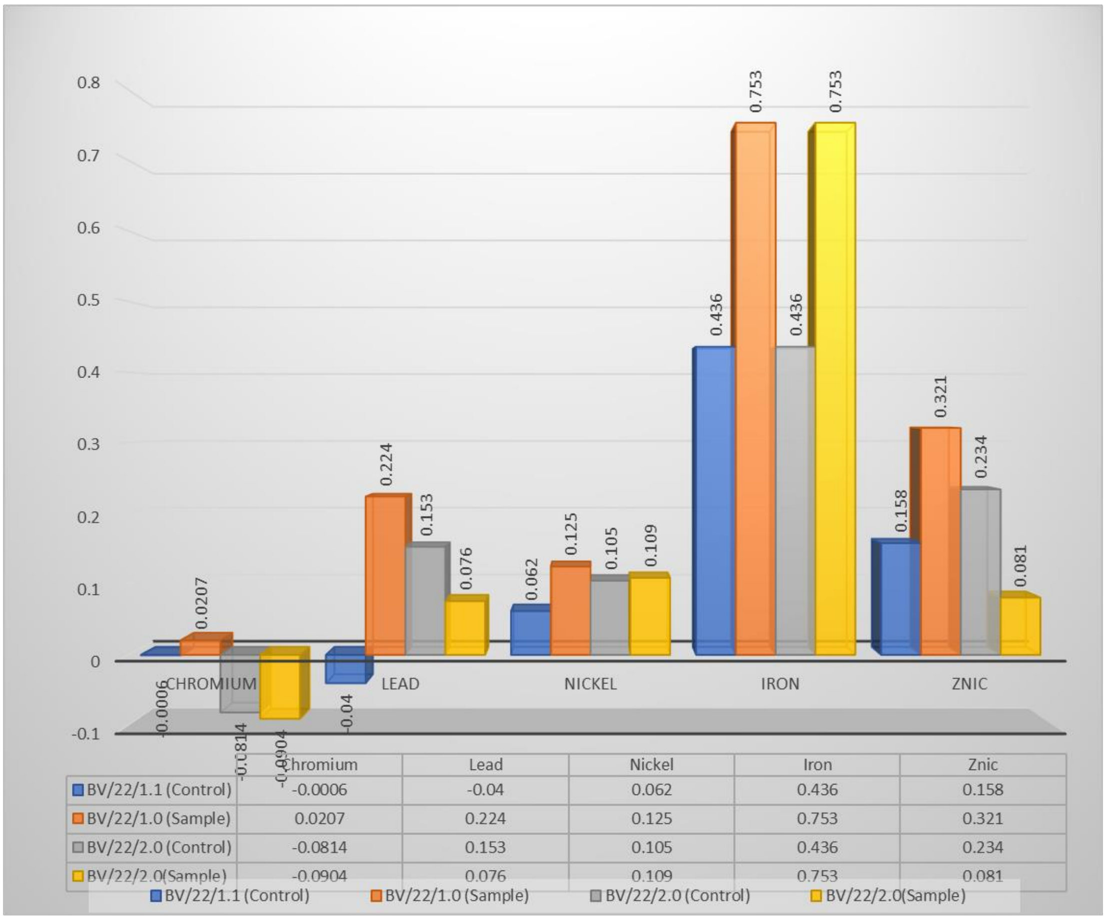
Graph 06: Estimated Result of Heavy Metal in Plastic and Biobased packagingmaterial for Model Simulant Distilled Water

is graph estimated result of heavy metal in plastic and biobased packaging material for model simulant distilled water. This graph concluded that biobased packaging material is more acceptable than the petroleum-based packaging material.



Graph 07: Estimated Result of Heavy Metal in Plastic and Biobased packaging material for Acetic Acid (3%)

This graph estimated result of heavy metal in plastic and biobased packaging material for model simulant acetic acid (3%). This graph concluded that biobased packaging material is more acceptable than the petroleum-based packaging material.



Graph 08: Estimated Result of Heavy Metal in Plastic and Biobased packagingmaterial

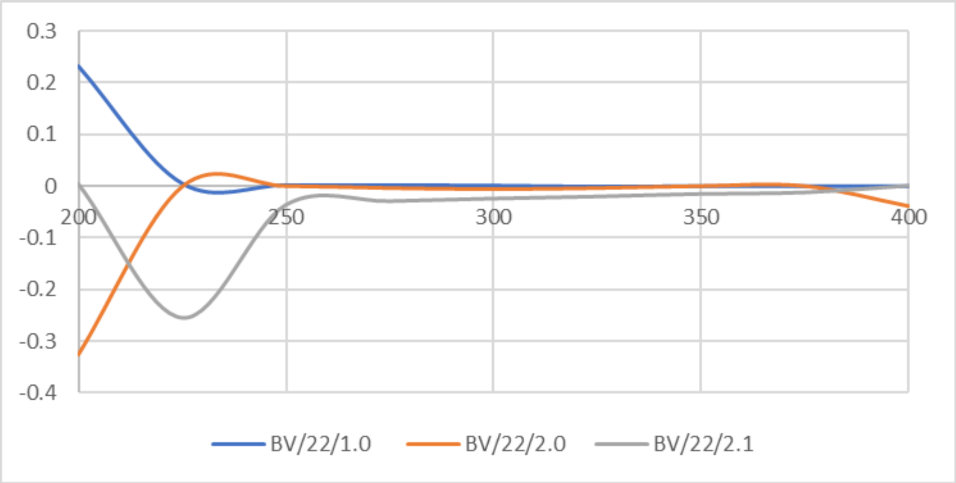
Normal Saline (0.9%)

This graph estimated result of heavy metal in plastic and biobased packaging material for model simulant normal saline (0.9). This graph concluded that biobased packaging material is more acceptable than the petroleum-based packaging material.

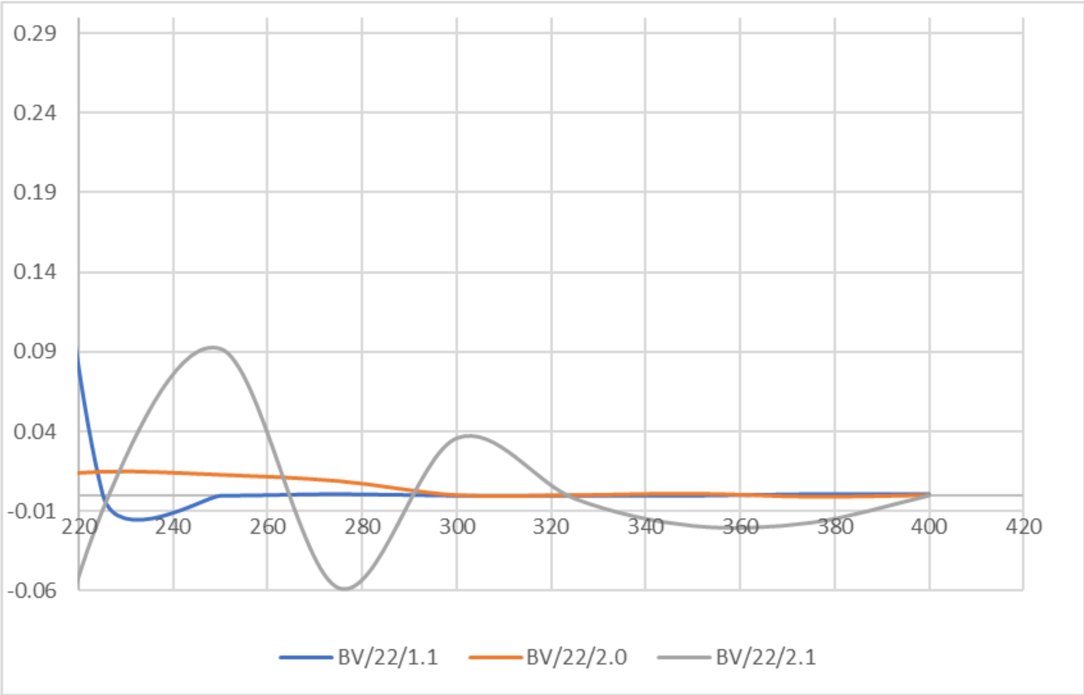
7.1 Estimated Result of UV-Absorbing Material

Graph 09: Heavy result of heavy metal in petroleum and biobased packaging material in model simulants Normal saline (9%)

For 40°C±2



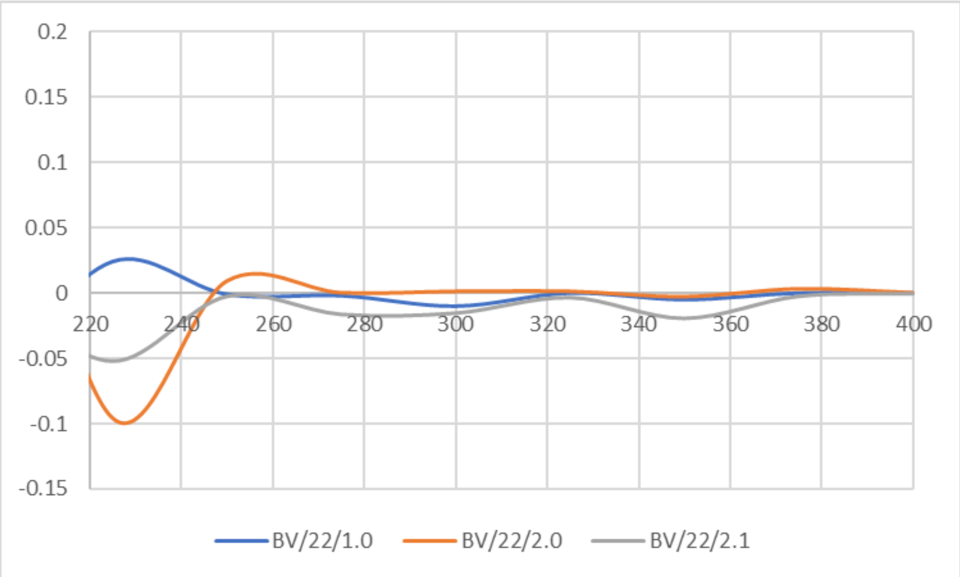
This line graph shows that optical density at the range of wavelength 200-400nm. It was concluded by that the optical density of samples were below the detection limits and sample BV/22/2.0 is more acceptable than other two sample.



Graph 10: Estimated Result of Heavy Metal in plastic and biobased packaging material in model Simulant Distilled Water

This line graph shows that optical density at the range of wavelength 200-400nm. It was concluded by that the optical density of samples were below the detection limits and sample BV/22/2.0 and BV/22/2.1 is more acceptable than the sample BV/22/1.0.

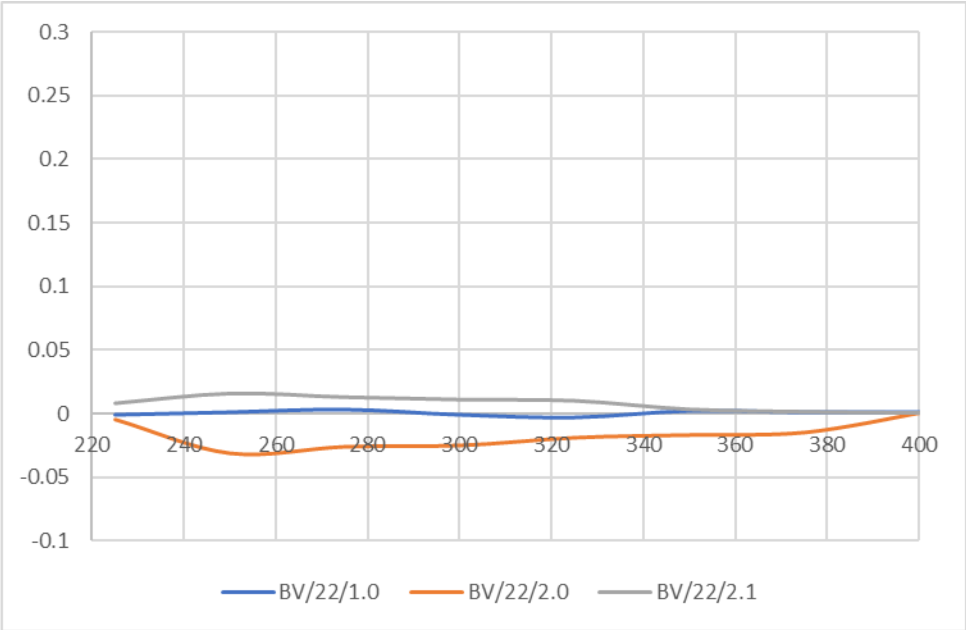
Graph 11: Estimated Result of Heavy Metal in plastic and biobased packaging material in model Simulant Acetic Acid



This line graph shows that optical density at the range of wavelength 200-400nm. It was concluded by that the optical density of samples were below the detection limits and sample BV/22/2.0 and BV/22/2.1 is more acceptable than the sample BV/22/1.0 at 40°C±2

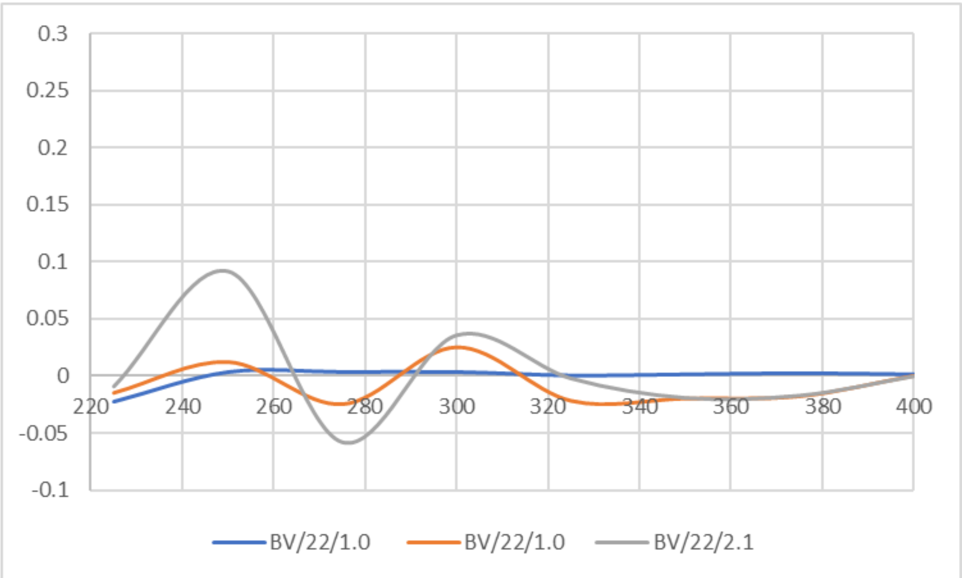
Graph 11: Estimated Result of Heavy Metal in plastic and biobased packaging material in model Simulant Normal Saline

For 60°C±2



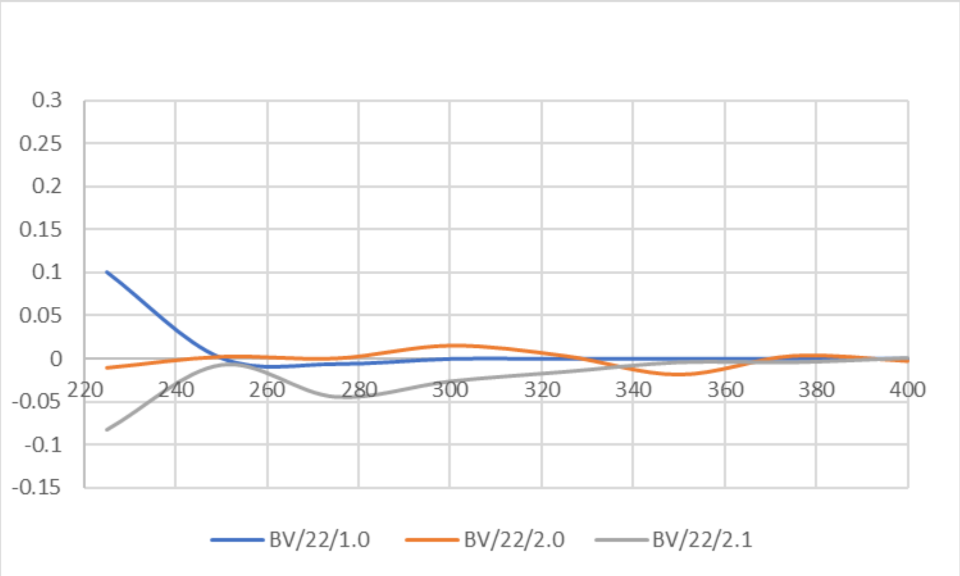
This line graph shows that optical density at the range of wavelength 200-400nm. It was concluded by that the optical density of samples were below the detection limits and sample BV/22/2.0 is more acceptable than the other two sample at 60°C±2**.**

Graph 12: Estimated Result of Heavy Metal in plastic and biobased packaging material in model Simulant Distilled Water



This line graph shows that optical density at the range of wavelength 200-400nm. It was concluded by that the optical density of samples were below the detection limits and sample BV/22/2.0, BV/22/2.1 is more acceptable than the sample BV/22/1.0at 60°C±2**.**

Graph 13: Estimated Result of Heavy Metal in plastic and biobased packaging material in model Simulant Acetic Acid (3%)



Graph 14: Estimated Result of Heavy Metal in plastic and biobased packaging material in model Simulant Normal Saline (9%)

This line graph shows that optical density at the range of wavelength 200-400nm. It was concluded by that the optical density of samples were below the detection limits and al samples are acceptable.

Food is very important in our life, without Food we can't able to live. And due to contamination, poor quality and inadequate quantity of food several diseases occur. Food packaging, should be tested by the ISO and OECD guidelines. According to BIS the water and food items should be packed in good quality plastic containers.At present, different types of packaging material plastics like polypropylene terephthalate etc, glass, metal, biobased materials are used for packaging of food. During manufacturing of plastic containers different types of chemicals, plasticizers, bisphenol-A are used, these additives were migrated into food items and it's are very harmful for human beings and environment. In order to understand "Food Packaging Materials: Application, Paradigms Shifts in Development Strategies with Toxicological Relevance" I have attempted to attain these objectives through estimation of the overall / global migration, UV- absorbing material (200-400nm), heavy metal in represented samples under simulated test conditions (40°C±2 & 60°C±2).

8. Conclusion

After conducting the study of on this petroleum based and biobased sample it was inferred that 3sample investigated were found to be within acceptable and migration value were below the permissible limit.

Food packaging is dynamic sector with paradigm shifts in strategic developments, market variability. etc. extensive studies are needed in new products prior to their marketing. With emphasis on banned of single use plastic, nondegradability issues. we need to minimize the usage of plastics.
The plastic and polymeric products must be evaluated as per specific guidelines for regulatory compliances.
When I was working than I took two different types of packaging materials such as Plastic and Biobased Packaging materials from the store to understand the safety values of the food packaging materials. The branded of packaging material were found to have appropriate marking and certification number. After testing the packaging material, it concluded that the migration of additives in food model simulants were beyond the permissible limit all samples were passed. Moreover, with in these samples biobased polymers was more effective than the petroleum based polymeric compound.

So, we switch our life toward the biobased polymeric rather than the petroleum-based compound. There are lots of advantages to use biobased polymeric compound. These compounds are non-toxic and biodegradable and eco-friendly.

Moreover, during my training period, I received the basic knowledge and importance of criteria related to a plastic test. The associated guidelines were also studied, and the significance of the permissible limits was understood.

I also acquired the knowledge of importance of quality management system (QMS), NABL and salient parameters related to plastic testing. My short-term training was very useful to know the importance of toxicological studies with relevance to polymeric products, and there was a process called a QMS and understanding the relevance of standard operating producers.

9. ANNEXURE I

9.1 Quality Control Management

The quality management system (QMS) is a set of corporate processes aimed at attaining quality and meeting client needs. It is defined as the organisational structure, rules, procedures, processes, and resources required to put quality management into action.

Ken Croucher coined the phrase "quality management system" in 1991. A British management consultant who is building and implementing a QMS genetic model.

When we are attempting to satisfy the customer's requirements and give them with contentment with our task? That leads to our organization's aim, as well as our ethics and values for our customers. All of these items are referred to as QMS.

9.2 Quality management system process

An organisational QMS includes a quality management system method. The ISO 9001-2000 standard requires organisations seeking compliance or certification to identify the processes that comprise the QMS, as well as their sequence and interaction. These include procedures like

● Order processing

● Production planning.

Management of product/service/process complaint with specified requirements including techniques such as statistical process control and management system analysis

- Calibration
- Internal audit.
- Corrective Action
- Preventive Action
- Identification, labelling and control of non-conforming product to preclude its advertent use, delivery or processing
- Purchasing and related processes such as supplier selection and monitoring

9.3 Quality Council of India

The Quality Council of India (QCI) was founded in 1996 as a national entity for accreditation based on the suggestions of the EU Expert Mission. The primary purpose of QCI was to establish an independent autonomous organisation with the assistance of the Government of India and the Indian Industrial, which was represented by the three leading industry associations:

(i) Associated Chambers of Commerce and Industry of India (ASSOCHAM),

(ii) Confederation of Indian Industry (CII)

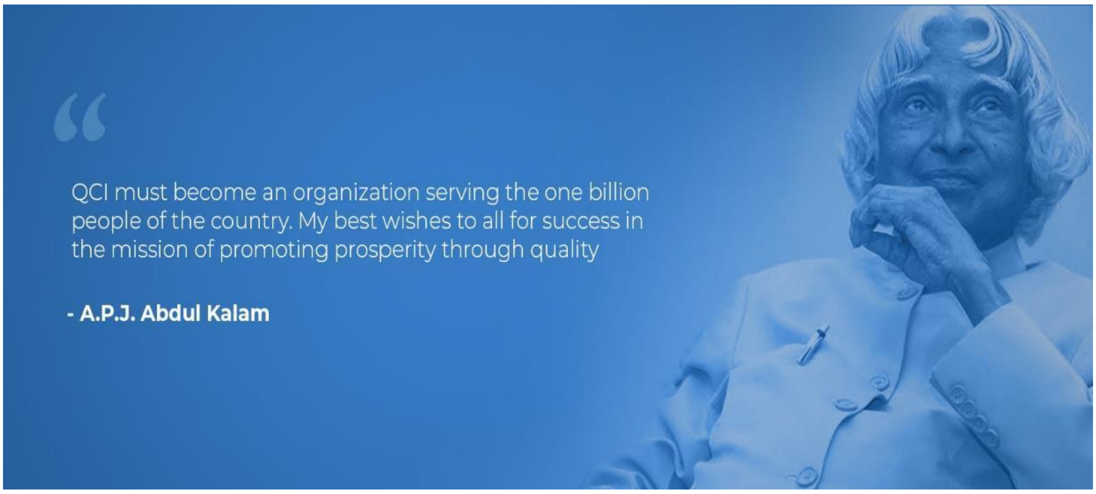
(iii) Federation of Indian Chambers of Commerce and Industry (FICCI).

QCI was established in accordance with the Societies Registration Act XXI of 1860. It is a not-for-profit organisation. QCI will organise and assist in the execution of the Cabinet decision.

QCI was created to provide a method for impartial third-party evaluation of products, services, and procedures. It plays an important role at the national level in spreading, adopting, and adhering to quality standards in all important spheres of activity such as education, healthcare, environmental protection, governance, social sectors, infrastructure sector, and such other organised activities that have a significant bearing on improving the quality of life and wellbeing of Indian citizens.

9.3.1 Mission of QCI

The purpose of QCI is to lead the quality movement in India by involving all stakeholders in order to improve quality standards in all fields of activity, with the primary goal of promoting and defending the nation's and its people' interests.



Vision of QCI

9.4 National Accreditation Board for Testing and Calibration Laboratories (NABL)

The National Accreditation Board for Testing and Calibration Laboratories (NABL) is an accreditation body which accreditation method adheres to ISO/IEC 17011. "Conformity Assessment -Accreditation Bodies Accrediting Conformity Assessment Bodies." NABL provides certification services on a voluntary basis to:

S. No	Standard	Laboratories
1	ISO/ IEC 17025	Testing laboratories (General Requirements for the Competence of Testing and Calibration Laboratories')
2	ISO/ IEC 17025	Calibration laboratories ('General Requirements for the Competence of Testing and Calibration Laboratories')
3	ISO 15189	Medical testing laboratories (Medical laboratories - Requirements for quality and competence')
4	ISO/IEC 17043	Proficiency Testing Providers (PTP) ("Conformity assessment — General requirements for proficiency testing")
5	ISO 17034	Reference material producers (RMP) ("General requirements for the competence of reference material producers")

Such an MRA lowers technical barriers to commerce and enables the acceptance of test/calibration

findings across nations represented by MRA partners. NABL was established with the goal of providing a scheme of Conformity Assessment Body accreditation to the government, industry associations, and industry in general, which involves third-party assessment of the technical competence of testing including medical and calibration laboratories, proficiency testing providers, and reference material producers. The NABL 100 "General information Brochure" contains information on the accreditation procedure.

NABL is self-sufficient and charges conformity assessment bodies fees to cover operations and other expenses.

NABL provides accreditation services that are non-discriminatory. These services are offered to all testing laboratories, proficiency testing providers, and reference material producers in India and other countries in the region, regardless of the applicant CAB's size, membership in any association or group, or the number of CABs presently licenced by NABL. Fees are included in the NABL 100 "General Information Brochure."

The disciplines and groups for which the accreditation services are offered in the respective fields are listed in –

- NABL 120 “Guidance for Classification of Product Groups in Testing & Calibration field”

- NABL 112 “Specific Criteria for Accreditation of Medical Laboratories”
- NABL 180 “Application Form for Proficiency Testing Providers (PTP)”
- NABL 190 “Application Form for Reference Material Producers Accreditation (RMP)”

NABL produces materials for CABs, Assessors, and internal usage. All NABL materials intended for use by anyone outside NABL are available for free on the NABL website at www.nabl-india.org >>publications>> NABL documents.

9.4.2 History of NABL

- In1973, Planning Commission suggested Department of Science & Technology (DST) to look into different aspects of testing facilities.
- In1981, DST submitted a proposal to planning Commission to establish a scheme.
- In1982, DST set up “National Coordination of testing & Calibration Facilities (NCTC)” for

providing accreditation services to testing & calibration laboratories.

- In 1991, Govt of India adopted a new policy on economic liberalization.
- In 1993, Renamed as NABL and aligned to International Standard.
- In 1998, Registered as an Aonomous Body (Societies Act 1860) under the aegis of DST
- In 2016, based on Cabinet Decision In 1996, NABL was a merged with Quality Council of India as a constituent Board.

The national accrediting board for testing and calibration laboratories (NABL) is an autonomous agency that reports to the department of science and technology. This agency is authorised by the government of India to give a third-party review of the lab's quality and technical ability. It is also affiliated with the Asia-Pacific Laboratory Accreditation Cooperation and the International Laboratory Accreditation Cooperation.

9.4.3 Benefits of NABL for Healthcare Providers

● Better control of laboratory operations and feedback

● In domestic & international markets there is a greater reach of products and recognition.

● From reduced retesting of products time and money can get saved.

● Due to customer confidence and satisfaction the potential get increase in the business.

● Superior competence in the process of calibration

9.4.4 Benefits of NABL for the people

- Assurance of genuine reports from accurately
- Elimination of the need for re-testing thereby saving money &time
- Satisfaction from the services provided
- Confidence in personnel performing tests

National accreditation board for testing and calibration laboratories (NABL), is an autonomous body under the aegis of department of science & technology, government of India and is registered under the societies act.

9.5 GOOD LABORATORY PRACTICES (GLP)

GLP, or good laboratory practises, is a quality management system for research laboratories and organisations that aims to ensure the uniformity, consistency, reliability, reproducibility, quality, and integrity of chemical (including pharmaceutical) non-clinical safety tests ranging from physicochemical properties to acute and chronic toxicity tests.

In reaction to a controversy at the Industrial Bioassay Institute, GLP was first implemented in New Zealand and Denmark in 1972, and subsequently in the United States in 1978. GLP's Organization for Economic Cooperation and Development continued a few years later, in 1992. Since then, the OECD has encouraged the expansion of GLP in a number of nations.

Nonclinical studies that examine the safety or effectiveness of substances for people, animals, and the environment are covered under GLP. The website of the UK Pharmaceutical and Medical Product Regulatory Authority, which defines GLP, has an internationally recognised definition of GLP.

GLP is a collection of principles that provides a framework for laboratory research to plan, perform, monitor, document, report, and archive. These studies address the dangers of medications (preclinical trials only), pesticides, cosmetics, food additives and contaminants, novel foods, biopesticides, and detergents to third parties, including users, consumers, and the environment. GLP is used to create data for risk assessment. It assures that risk / safety evaluations are trustworthy since the data presented correctly represents the study's conclusions.

GLP, a data quality system, should not be confused with laboratory glove, goggles, and clothing regulations for safe material handling.

9.6 ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

The Organization for Economic Cooperation and Development (OECD) is a 34-country international economic organisation that was founded in 1961 to promote economic advancement and global commerce. This is a forum for nations working on democracy and market economies to discover solutions to shared challenges, identify best practises, and to compare policy experiences in order to coordinate member national and international policies.

The Organization for European Economic Co-operation and Cooperation (OECD) was created in 1948 as the Organization for European Economic Co-operation and Cooperation (OEEC), chaired by Robert Majolin of France, to help in the implementation of the Marshall Plan (rejected by the Soviet Union and its satellite states). This is accomplished through the provision of US financial assistance and the implementation of economic programmes for the reconstruction of Europe following World War II, where similar efforts were made under the US Economic Cooperation Act of 1948, which mandated the Marshall Plan, and also occurred elsewhere in the world, including the war-torn Republic of China and post-war South Korea, but America's reconstruction programme in Europe was the most successful.

The OEEC was renamed the Organization for Economic Cooperation and Development in 1961, and membership was expanded to include non-European countries. The majority of OECD nations are high-income, industrialised countries with very high Human Development Index (HDI).Organization for European Economic Cooperation.

The Organization for European Economic Cooperation (OEEC) was founded in 1948 to administer US and Canadian contributions under the Marshall Plan for postwar European rebuilding. On April 16, 1948, it entered into service. It has been based in Château de Lamuette in Paris, France, since 1949. Following the termination of the Marshall Plan, the OEEC concentrated on economic matters.

In the 1950s, the OEEC served as a negotiation framework for forming the European Free Trade Association, which would bring together the six European Economic Communities and other OEEC members on a multilateral basis. The OEEC established a European nuclear energy agency in 1958.

9.7 INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO is an abbreviation for the International Organization for Standardization. It is an international standard-setting organisation made up of delegates from various national standards bodies. ISO was formed on February 23, 1947, to promote international proprietary, industrial, and commercial standards. It operates in 164 countries and is based in Geneva, Switzerland. ISO was among the first organisations to be awarded general consultative status with the UN Economic and Social Council.

History - Founded in 1920 as the International Federation of National Standardizing Associations (ISA), the organisation is currently known as ISO. However, it was stopped during World War II, and in October 1946, ISA and UNSCC delegated and met in London with the 25 countries, and then decided to join forces to form a new international body for standards. The new organisation was formally launched in February 1947. ISO has issued over 21,584 standards, has members in 162 countries, and has 788 technical organisations for standard creation. The organisation also reported an 8% rise in certification in 2016, going from 1,520,368 to 1,643,523.

Some of the ISO standards are:

1. ISO 9000 – Quality management

2. ISO/IEC 27000 – information security management system

3. ISO 14000 – environmental management

4. ISO 31000 – risk management 5. ISO 50001 – energy management

6. ISO 26000 – Social responsibility

7. ISO 28000: 2007 – specifications for security management system for the supply chain.

8. ISO 37001: 2016 – antibribery management system

9. ISO 15270:2008- Plastic- Guidelines for the recovery and recycling of plastics waste

20.ISO 18606:2013(en)- Packaging and the environment — Organic recycling

21. ISO 2873:2000, Packaging -- Complete, filled transport packages and unit loads -- Low pressure test

22. ISO 2875:2000, Packaging -- Complete, filled transport packages and unit loads -- Water-spray test

23. ISO 17088:2012 – The four following aspects are addressed on composability.

a) biodegradation

b) disintegration during composting

c) negative effects on the composting process and facility

d) negative effects on the quality of the resulting compost, including the presence of high levels of regulated metals and other harmful components

ASTM D6400 – Degradation of Plastic

CEN – European Committee for Standardization (European Union)

According to EN 13432 composability standard

- Chemical test
- Biodegradability in controlled composting conditions (oxygen consumption and production of CO_2)
- Disintegration
- Practical test of composability in a semi-industrial (or industrial) composting facility
- Ecotoxicity test

9.8 BUREAU OF INDIAN STANDARD (BIS)

Bis is the national standards body which works for the government of India, food and public distributions and ministry of consumer affairs. It also provides traceability benefits to national economy in the following ways –

1. By minimizing health hazards to consumers

2. By providing good quality reliable

3. Control the over proliferation of the varieties etc by testing, certification and standardization.

The Bureau of Indian Standards Act was founded in 1986 and went into force on December 23, 1986. It is also formed for the harmonious development of standardisation, quality certification of goods, and marking activities, as well as topics related to or incidental to these operations.

Organization - (NITS) – in 1995, NITS get setup and is a training institute of BIS. It works from Noida, U.P and India. The 1* activities of NITS are: -

1. For industry in-house and open training programme

2. For developing countries international training programme

3. Training programme to its employees

Laboratories - A network of eight laboratories has been discovered in BIS. These laboratories have product testing facilities for food, electrical, and mechanical disciplines. In the BIS facilities, roughly 25000 samples are analysed each year. All other labs, with the exception of two, are NABL (National Accreditation Board for Testing and Calibration Laboratories) certified.

Collaboration with international standards bodies –

BIS was discovered as a founding member of all international organizations for standards. It also represents India in international organizations such as the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the World Standards Service Network (WSSN). One of the bureau's primary tasks is the formulation, development, and recognition of Indian standards. BIS, on January 1Jan 2019 20000 standards have been developed, and they also cover major parts of the economy, assisting the industry in improving the quality of its products and services.

9.9Survey on Slum workers (Who Collect Plastic) to Understand their life style

Survey Form

CSIR – Indian Institute of Toxicology Research

31, Mahatma Gandhi Marg, P.O Box NO. 80 Lucknow – 226001

Uttar Pradesh

Questionnaire

Proforma No	
Proforma Date	

Section A: Personal Information

Name	
Father /Husband's Name	
Father/Husband' Education	
Father/Husband' Occupation	
Salary / Month & Year	
Mother/Wife's Name	
Mother/Wife's Education	
Mother/Wife's Occupation	
Salary / Month & Year	

Children	

Boys		**Age**		**Education**	
Girl		**Age**		**Education**	

Category		**Nationality**	

Permanent Address	………………………………………………………………………………… ……………………………………………………………………………….. ………………………………………………………………………………… ………………………………………………………………………………. **Contact Number** ………………………………………………. ………………………………………………………………………………. **Alternative Number** ……………………………………………….

Email. Id / Other social media Account	

Any other Id	

Section: B

No of Adult Work	………………………………………………………………… …………………………………………………………………
Working Area	………………………………………………………………… …………………………………………………………………
Area of dumping the waste	………………………………………………………………… …………………………………………………………………
Types of waste Collection	………………………………………………………………… …………………………………………………………………
Problem facing during collection of waste	………………………………………………………………… …………………………………………………………………
Sanitation Facility	………………………………………………………………… …………………………………………………………………
Medical Facility	………………………………………………………………… …………………………………………………………………
Purify water Facility	………………………………………………………………… …………………………………………………………………
Method of Disposing waste	…………………………………………………………………

	………………………………………………………………
No of work's required during disposing the waste	……………………………………………………………….. …………………………………………………………………
Knowledge about Plastic	………………………………………………………………….. …………………………………………………………………..
Knowledge about current Scenario	…………………………………………………………………… ……………………………………………………………………
Current Financial Status	…………………………………………………………………….. ………………………………………………………………………
Current Social Status	……………………………………………………………………… ………………………………………………………………………
Support By government & private organization	…………………………………………………………………………

Remark: The life of Slum works was very poor. They were not aware the toxic effect of plastic. During the collection of plastic, they were not use gloves, masks and other precautions.

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Annexure II

सत्यमेव जयते

National Good Laboratory Practice (GLP) Compliance Monitoring Authority (NGCMA)
Department of Science and Technology
GOVERNMENT OF INDIA

Certificate of GLP Compliance

This is to certify that

GLP Test Facility, CSIR-Indian Institute of Toxicology Research
Gheru Campus, Sarojini Nagar Industrial Area, Kanpur Road
Lucknow – 226008, Uttar Pradesh (India)

is a GLP certified test facility in compliance with the NGCMA's Document No. GLP-101 "Terms & Conditions of NGCMA for obtaining and maintaining GLP certification by a test facility" and OECD Principles of GLP.

The test facility conducts the below-mentioned tests/ studies:

- **Toxicity Studies**
- **Mutagenicity Studies**
- **Environmental Toxicity Studies on Aquatic and Terrestrial Organisms**
- **Analytical and Clinical Chemistry Testing**

The specific areas of expertise, test items and test systems are listed in the annexure overleaf.

Validity: June 5, 2020 – June 4, 2023

Certificate No. : GLP/C-154/2020
Issue Date : 13-10-2020

(Dr. Neeraj Sharma)
Head, NGCMA

[redacted]

2nd INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN BIOTECHNOLOGY AND NANOBIOTECHNOLOGY (Int-BIONANO-2022)

Amity Institute of Biotechnology, Amity University Madhya Pradesh, Gwalior

CERTIFICATE

This certificate is awarded to Ms. Bhoomika Varshney from Department of Bioengineering, Integral University, Kursi Road, Lucknow, UP, India For her presentation of research paper titled Treading Approaches to Bridge Traditional and Modernity in Food Packaging in the 2nd International Conference on Recent Advances in Biotechnology and Nanobiotechnology (Int-BIONANO-2022) during 10-11 February 2022

Prof.(Dr.) Rajesh Singh Tomar
Convener

Lt. Gen. V. K. Sharma, AVSM (Retd.)
Chairperson

NATIONAL ACCREDITATION BOARD FOR TESTING AND CALIBRATION LABORATORIES (NABL)

(*A Constituent Board of Quality Council of India*)

CERTIFICATE OF ATTENDANCE

Bhoomika Varshney

has attended

"Proficiency Testing Provider (PTP) Awareness Program"

Organized by

National Accreditation Board for Testing and Calibration Laboratories (NABL), Gurugram

held on 20th May, 2022 at Lucknow

N. Venkateswaran
Chief Executive Officer

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- Cwiek-Ludwicka K, Stelmach A, Jurkiewicz M, Mazańska M, Półtorak H. Badania migracji globalnej z zastosowaniem alternatywnych płynów modelowych zywności zawierajacej tłuszcz [Overall migartion testing with alternative fatty food simulants]. Rocz Panstw Zakl Hig. 2006;57(3):259-65. Polish. PMID: 17193746.
- In 2006, Cwiek-Ludwicka K, et.al performed an experiment to test the overall migration in food packaging material this test is performed for the test the overall migration in fat containing food so they prepare a simulant according to the European standard EN 1186 and observed the result and accepted value was below the 10mg/dm2.
- Are you a Smart Recycler? Part 5: https://recycle1st.co.za/2021/08/11/are-you-a-smart-recycler-part-5/
- Resin Comparison Guide: https://www.clsmith.com/resin-comparison-chart/
- Source:https://www.facebook.com/ActionForNature/photos/plastic-pollution-not-only-hurts-the-earth-and- animals-it-harms-human-health-and/10155366561365706/?_rdr
- What Are the Different Types of Plastic? https://www.qualitylogoproducts.com/promo-university/different-types-of-plastic.htm
- Plastic-Molding & Manufacturing/Plastic Additives- https://en.m.wikibooks.org/wiki/Plastic-

Molding_%26_Manufacturing/Plastic_Additives

- Polymer - https://en.m.wikipedia.org/wiki/Polymer
- Bioplastics – Standards and Certifications- https://www.bioplastics.guide/ref/bioplastics/standards-and-certifications/
- QCI: https://www.qcin.org/
- NABL: https://nabl-india.org/
- ISO Guidelines: https://www.iso.org/obp/ui/#iso:std:iso:18606:ed-1:v1:en

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