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Department of Chemical Engineering

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NAAC Accredited A+

CERTIFICATE

This is to certify that the project work entitled **"PHOTOCATALYTIC DEGRADATION OF RHODAMINE-B USING GREEN SILVER NANO PARTICLES"**, is being submitted by **A. HARI VENKATA KRISHNA REDDY (191FA02001), G. SURYA VAMSI (191FA02006), J. SANDEEP (191FA02007), K. NAGARJUNA (191FA02012), P. MOUNIKA CHOWDARY (191FA02015)** for partial fulfilment for the award of Bachelor of Technology in Chemical Engineering to **Vignan`s Foundation for Science, Technology and Research (Deemed to be University)** during 2022-2023, is a record of work carried out by them under our supervision. The results embodied in this work have not been submitted to any other university or institute for the award of any degree or diploma.

Project Guide
Dr.B.Sumalatha

Coordinator - UG Projects
Dr.P.Vijetha

Head of the Department
Dr.M.Ramesh Naidu

Signature of External Examiner

Qualitus
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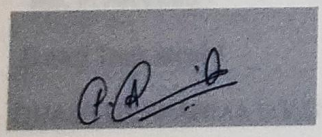
TO WHOM IT MAY CONERN

We are glad to inform you that **Mr. B. Gowtham (191FA02003)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH,** Guntur has successfully completed her internship at Qualitus Pharma Solutions from 23-01-2023 to 29-05-2023.

During her internship, her was exposed to the various activities in **"Utility Design"** under the guidance of **Mr. P. ARVIND,** Head of the Department.

We found her very inquisitive and hard working. She was very much interested to learn the functions of our core division and also willing to put her best efforts and get in to the depth of the subject to understand it better.

Her association with us was very fruitful and we wish her all the best in her future endeavors.



Mr. P. ARVIND

(Lead Technical)

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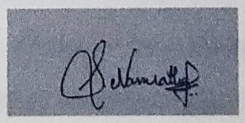

Ms. S. NAMRATHA

(Projects Coordinator)

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Foundation for Science, Technology & Research
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CERTIFICATE

This is to certify that the Project Report entitled **"Utilization Of Borassus Flabellifer Fruit Husk Biochar For Simazine Removal From Wastewater"** prepared by **GEHLOT BHERU (191FA02004), KOLAKALURI RISHI KUMAR GNANI (191FA02011), P RAJIV PRABHU CHANDRA RAJU (191FA02017), SYED WAHAB (191FA02020), YELLAPU UMA DEVI (191FA02022)** is submitted in partial fulfilment for the award of B. Tech Degree in Chemical Engineering by the Vignan's Foundation for Science, Technology and Research University is a record of bonified work carried out in the Department of Chemical Engineering.

Signature of Guide
Dr. M. Ramesh Naidu
& Dr. N. Rama Gopal

Signature of HOD
Dr. M. Ramesh Naidu

Signature of External Examiner

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
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NAAC Accredited A+

CERTIFICATE

This to certify that thesis entitled "**ADSORPTION STUDIES ON SCARLET ORANGE USING BIOCHAR DERIVED FROM AZADIRACTHA INDICA (NEEM BARK)** " submitted by **B.MANOJ REDDY (191FA02005), V.NISCHAL (191FA02028), M.ARUN SAI (191FA02031), D.MANOHAR REDDY (201LA02004), A.VISHNU (191FA17001)** in partial fulfilment for their requirements for the award of Bachelor of Technology degree in **Chemical Engineering** at **VFSTR** and is prepared by them under my supervision and guidance.

Dr. P.VIJETHA
Associate Professor
Department of Chemical Engineering
VFSTR,Vadlamudi

Dr. M. Ramesh Naidu
Professor and HOD
Department of Chemical Engineering
VFSTR,Vadlamudi

External Examiner

CIN : U24110AP1989PLC009723

HETERO LABS LIMITED (UNIT-IX)

Plot No. 2, HETERO INFRASTRUCTURE SEZ LTD, N. Narasapuram (Village), Nakkapalli (Mandal),
VISAKHAPATNAM (Dist.) - 531 081, A.P., India. Tel : +91-891-2877770, Fax : +91-891-2877755
E-mail . contact@heterodrugs.com. URL : http//www.heteroworld.com

Date: 08-05-2023
Place: Nakkapalli

TO WHOM IT MAY CONERN

We are glad to inform you that **Mr.KAMAKSHI HEMANTH RAO (191FA02008)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH,** Guntur has successfully completed his internship at ***Hetero Labs Limited*** from **14-02-2023 to 08-05-2023.**

During his internship, he was exposed to the various activities in "**Technical Service Department**" under the guidance of **Mr. K.KARUNAKUMAR**, Head of the Department.

We found his very inquisitive and hard working. He was very much interested to learn the functions of our core division and also willing to put his best efforts and get in to the depth of the subject to understand it better.

His association with us was very fruitful and we wish him all the best in his future endeavours.

For Hetero Labs Limited

Authorized Signatory

K.KARUNAKUMAR
HOD-TSD

CIN : U24110AP1989PLC009723

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VISAKHAPATNAM (Dist.) - 531 081, A.P., India. Tel : +91-891-2877770, Fax : +91-891-2877755
E-mail : contact@heterodrugs.com. URL : http//www.heteroworld.com.

Date: 08-05-2023
Place: Nakkapalli

TO WHOM IT MAY CONERN

We are glad to inform you that **Mr.KARIMSAHEB GARI MOHAMMAD RAFI (191FA02009)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH,** Guntur has successfully completed his internship at ***Hetero Labs Limited*** from **14-02-2023 to 08-05-2023**.

During his internship, he was exposed to the various activities in **"Technical Service Department"** under the guidance of **Mr. K.KARUNAKUMAR**, Head of the Department.

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His association with us was very fruitful and we wish him all the best in his future endeavours.

For Hetero Labs Limited

Authorized Signatory

K.KARUNAKUMAR
HOD-TSD

"Hetero Corporate" 7-2-A2, Industrial Estates, Sanath Nagar, HYDERABAD - 500 018, Telangana, India.
Tel : +91-40-23704923/24/25, Fax : +91-40-23813359.

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HETERO LABS LIMITED (UNIT-IX)

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E-mail : contact@heterodrugs.com URL : http//www.heteroworld.com

Date: 08-05-2023
Place: Nakkapalli

TO WHOM IT MAY CONERN

We are glad to inform you that **Ms.NAKKA VENKATA NAGA DURGA(191FA02013)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH**, Guntur has successfully completed her internship at ***Hetero Labs Limited*** from **14-02-2023 to 08-05-2023.**

During her internship, she was exposed to the various activities in **"Technical Service Department"** under the guidance of **Mr. K.KARUNAKUMAR**, Head of the Department.

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For Hetero Labs Limited

Authorized Signatory

K.KARUNAKUMAR
HOD-TSD

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Foundation for Science, Technology & Research
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NAAC Accredited A+

CERTIFICATE

This is to certify that the project work entitled **"PYROLYTIC KINETIC STUDIES OF BAMBUSA VULGARIS LEAVES AND IT'S FIBERS",** is being submitted by **P.PRABHUTEJA (191FA02016)** for partial fulfilment for the award of Bachelor of Technology in Chemical Engineering to **Vignan`s Foundation for Science, Technology and Research (Deemed to be University)** during 2022-2023, is a record of work carried out by his/her under our supervision. The results embodied in this work have not been submitted to any other university or institute for the award of any degree or diploma.

Dr. P. Vijetha
Project Guide

Dr. P. Vijetha
Coordinator - UG Projects

Dr. M. Ramesh Naidu
Head of the Department

Signature of External Examiner

Qualitus
uality by design

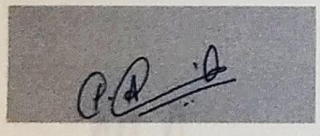
TO WHOM IT MAY CONERN

We are glad to inform you that **Ms. R. Divya (191FA02018)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH,** Guntur has successfully completed her internship at Qualitus Pharma Solutions from 23-01-2023 to 29-05-2023.

During her internship, her was exposed to the various activities in **"Facility Design"** under the guidance of **Mr. P. ARVIND,** Head of the Department.

We found her very inquisitive and hard working. She was very much interested to learn the functions of our core division and also willing to put her best efforts and get in to the depth of the subject to understand it better.

Her association with us was very fruitful and we wish her all the best in her future endeavors.



Mr. P. ARVIND

(Lead Technical)

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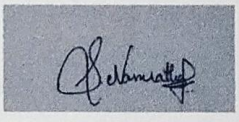

Ms. S. NAMRATHA

(Projects Coordinator)

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CIN : U24110AP1989PLC009723

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E-mail contact@heterodrugs.com URL http://www.heteroworld.com

Date: 08-05-2023
Place: Nakkapalli

TO WHOM IT MAY CONERN

We are glad to inform you that **Mr.TANIKELLA KRISHNA SAI BHARADWAJ (191FA02021)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH**, Guntur has successfully completed his internship at ***Hetero Labs Limited*** from **14-02-2023 to 08-05-2023.**

During his internship, he was exposed to the various activities in **"Technical Service Department"** under the guidance of **Mr. K.KARUNAKUMAR**, Head of the Department.

We found his very inquisitive and hard working. He was very much interested to learn the functions of our core division and also willing to put his best efforts and get in to the depth of the subject to understand it better.

His association with us was very fruitful and we wish him all the best in his future endeavours.

For Hetero Labs Limited

Authorized Signatory

K.KARUNAKUMAR
HOD-TSD

CIN : U24110AP1989PLC009723

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E-mail : contact@heterodrugs com URL : http//www heteroworld com

Date: 08-05-2023
Place: Nakkapalli

TO WHOM IT MAY CONERN

We are glad to inform you that **Mr.KOLIMARLA BAJI BABU (191FA02026)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH,** Guntur has successfully completed his internship at ***Hetero Labs Limited*** from **14-02-2023 to 08-05-2023.**

During his internship, he was exposed to the various activities in **"Technical Service Department"** under the guidance of **Mr. K.KARUNAKUMAR,** Head of the Department.

We found his very inquisitive and hard working. He was very much interested to learn the functions of our core division and also willing to put his best efforts and get in to the depth of the subject to understand it better.

His association with us was very fruitful and we wish him all the best in his future endeavours.

For Hetero Labs Limited

Authorized Signatory

K.KARUNAKUMAR
HOD-TSD

Jocil Limited

An ISO 9001:2015 Certified Company

Box 216, Arundelpet P.O., Guntur-522 002, Andhra Pradesh, India
Ph: 0863-2290190 • Fax: 0863-2290090 • Email: jocil@jocil.net • Web: www.jocil.in

Jocil

Jocil/Adm/182/23/ 480

June 12, 2023

Industrial Training Completion Certificate

1.	Name	: Syed Faiz [191FA02027]
2.	Name and Address of the Institution	: Vignan's University, Vadlamudi, Guntur Dist.
3.	Subject & Field of Study	: B.Tech. (Chemical Engineering)
4.	**Period of Training**	: 07-02-2023 to 31-05-2023
5.	Area of Training	: Production Dept.
6.	Project Report Title	: Study of "Production of Stearic Acid Flakes" at Jocil Limited, Dokiparru.
7.	Performance	: Satisfactory

Managing Director

To

Head of the Department,
Vignan's University,
Vadlamudi, Guntur Dist.

Jocil Limited *An ISO 9001:2015 Certified Company*

Box 216, Arundelpet P.O., Guntur-522 002, Andhra Pradesh, India
Ph : 0863-2290190 • Fax : 0863-2290090 • Email : jocil@jocil.net • Web : www.jocil.in

Jocil/Adm/182/23/ 472

June 03, 2023

Industrial Training Completion Certificate

1. Name	:	T. Kasi Mahesh [191FA02029]
2. Name and Address of the Institution	:	Vignan's University, Vadlamudi, Guntur Dist.
3. Subject & Field of Study	:	B.Tech. (Chemical Engineering)
4. Period of Training	:	07-02-2023 to 31-05-2023
5. Area of Training	:	Fatty Splitting Plant
6. Project Report Title	:	Study of "Fat Splitting Plant" at Jocil Limited, Dokiparru.
7. Performance	:	Satisfactory

Managing Director

To

Head of the Department,
Vignan's University,
Vadlamudi, Guntur Dist.

TO WHOM IT MAY CONCERN

We are glad to inform you that **Ms. LIOL ANYIEL AGOTH KIJOK** from Vignan's Foundation for Science, Technology and Research has successfully completed her internship at Lee Pharma Limited from 21/02/2023 to 24/05/2023.

During her internship, she was exposed to the various activities related to Research & Development, Technical Service Division and Quality Assurance.

We found her very inquisitive and hard working. she was very much interested to learn the functions of our core division and also willing to put her best efforts and get into the depth of the subject to understand it better.

Her association with us was very faithful and we wish her all the best in her future endurance.

For Lee Pharma Limited

LEE PHARMA LIMITED 502319

24/05/2023

Authorized Signature

TO WHOM IT MAY CONCERN

We are glad to inform you that **Mr. VIVEK KUMAR** from Vignan's Foundation for Science, Technology and Research has successfully completed his internship at **Lee Pharma Limited** from 21/02/2023 to 24/05/2023.

During his internship, he was exposed to the various activities related to **Research & Development, Technical Service Division and Quality Assurance.**

We found him very inquisitive and hard working. He was very much interested to learn the functions of our core division and also willing to put his best efforts and get into the depth of the subject to understand it better.

His association with us was very faithful and we wish him all the best in his future endurance.

For Lee Pharma Limited

LEE PHARMA LTD. 502319 24/05/2023

Authorized Signature

Lee Pharma Limited
An ISO 9001 & 14001, EU GMP & WHO GMP
CIN : U24230TG1997PLC028095

TO WHOM IT MAY CONCERN

We are glad to inform you that **Mr. B JNANA SOURABH** from Vignan's Foundation for Science, Technology and Research has successfully completed his internship at Lee Pharma Limited from 21/02/2023 to 24/05/2023.

During his internship, he was exposed to the various activities related to Research & Development, Technical Service Division and Quality Assurance.

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For Lee Pharma Limited

Authorized Signature 24/05/2023

Lee Pharma Limited
AN ISO 9001 & 14001, EU GMP & WHO GMP
CIN : U24230TG1997PLC028095

TO WHOM IT MAY CONCERN

We are glad to inform you that **Mr. K SAI VAMSI REDDY** from Vignan's Foundation for Science, Technology and Research has successfully completed his internship at Lee Pharma Limited from 21/02/2023 to 24/05/2023.

During his internship, he was exposed to the various activities related to Research & Development, Technical Service Division and Quality Assurance.

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His association with us was very faithful and we wish him all the best in his future endurance.

For Lee Pharma Limited

24/05/2023

Authorized Signature

CIN : U24110AP1989PLC009723

HETERO LABS LIMITED (UNIT-IX)

Plot No. 2, HETERO INFRASTRUCTURE SEZ LTD, N. Narasapuram (Village), Nakkapalli (Mandal),
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E-mail : contact@heterodrugs.com. URL : http//www.heteroworld.com.

Date: 08-05-2023
Place: Nakkapalli

TO WHOM IT MAY CONERN

We are glad to inform you that **Mr.BANDA SAI SUDHEER KUMAR(201LA02003)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH,** Guntur has successfully completed his internship at ***Hetero Labs Limited*** from **14-02-2023 to 08-05-2023**.

During his internship, he was exposed to the various activities in **"Technical Service Department"** under the guidance of **Mr. K.KARUNAKUMAR**, Head of the Department.

We found his very inquisitive and hard working. He was very much interested to learn the functions of our core division and also willing to put his best efforts and get in to the depth of the subject to understand it better.

His association with us was very fruitful and we wish him all the best in his future endeavours.

For Hetero Labs Limited

Authorized Signatory

K.KARUNAKUMAR
HOD-TSD

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TO WHOM IT MAY CONERN

We are glad to inform you that **Ms. K. Prasanna (191FA02010)** from **VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY & RESEARCH,** Guntur has successfully completed her internship at Qualitus Pharma Solutions from 23-01-2023 to 29-05-2023.

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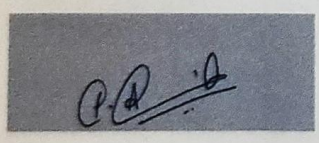

Mr. P. ARVIND

(Lead Technical)

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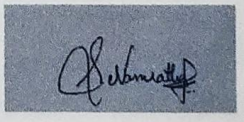

Ms. S. NAMRATHA

(Projects Coordinator)

QUALITUS PHARMA SOLUTION

A

FIELD PROJECT REPORT

ON

"EXTRACTION OF ANTIOXIDANTS FROM MEDICINAL PLANTS"

Submitted in the partial fulfillment of the requirements for the award of the degree
BACHELOR OF TECHNOLOGY

In
Department of Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

(ACCREDITED BY NAAC WITH 'A'GRADE)

Submitted by: -

NAME OF STUDENT	REGD NO
K. LASYA	*201FA02002*
Y. VIDIHYA	*201FA02003*
USHA SRI	*211LA02001*
B. SRIKARDATTA	*201FA17001*

Under Supervision of :- **DR. P. ASHOK KUMAR**

DEPARTMENT OF CHEMICAL ENGINEERING

VIGNAN'S FOUNDATION FOR SCIENCE, TECHNOLOGY AND RESEARCH

GUNTUR, VADLAMUDI - 522213

MAY :- 2023

ACKNOWLEDGEMENT

I would like to thank my guide **DR. P. ASHOK KUMAR** Vignan's foundation for science technology and research, Vadlamudi. The interaction with her was really, fruitful and helped me in compiling this field project report. My deepest thanks to Dr. M. Ramesh Naidu Head of Chemical Department VFSTR, Vadlamudi for guiding me and extending all possible help to me and always inspiring me to do my work on this project report with sincerity. Also, I would like to thank whose **DR. P. ASHOK KUMAR** trust and enthusiasm was constant motivation during ongoing work. Last but not least I would like to thankful to all staff members of Department of Petroleum Engineering, Vignan University, Vadlamudi and who directly or indirectly helped me in the completion of this project report.

UNDERTAKING

This is to declare that the Field project entitled "EXTRACTION OF ANTIOXIDANTS FROM MEDICINAL PLANTS" is an original work done by undersigned, in partial fulfillment the requirements for the degree "Bachelor of Technology" from Department of Chemical Engineering, All the analysis, design and system development have been accomplished by the undersigned. Moreover, this project has not been submitted to any other college oruniversity.

K. LASYA	***201FA02002***
Y. VIDIHYA	***201FA02003***
USHA SRI	***211LA02001***
B. SRIKARDATTA	***201FA17001***

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
Estd. u/s 3 of UGC Act 1956

CERTIFICATE

This is to certify that the field project entitled as, "EXTRACTION OF ANTIOXIDANTS FROM MEDICINAL PLANTS" submitted by 211LA02001, 201FA02003, 201FA02002, 201FA17001 to the Vignan's Foundation for Science, Technology and Research (Deemed to be) University, Guntur, Andhra Pradesh for the award of the degree of Bachelor of Technology is a bonafide record of the research work done by him/her under my supervision. The contents of this thesis, in full or in part, have not been submitted to any other institute or university for the award of any Degree.

Project Guide

(Head of the Department)

HEAD
Department of Chemical Engineering
VIGNAN'S FOUNDATION
FOR SCIENCE, TECHNOLOGY & RESEARCH
(Declared to be Deemed University U/S 3 of UGC Act 1956)
VADLAMUDI-522 213, A.P. INDIA

ABSTRACT

The phytochemicals present in plants are responsible for preventing disease and promoting health have been studied extensively to establish their efficacy and to understand the underlying mechanism of their action. Such studies have included identification and isolation of the chemical components, establishment of their biological potency both by in vitro and in vivo studies in experimental animals and through epidemiological and clinical-case control studies in man. Study findings suggest that phytochemicals may reduce the risk of coronary heart disease by preventing the oxidation of low density lipoprotein (LDL) cholesterol, reducing the synthesis or absorption of cholesterol, normalizing blood pressure and clotting, and improving arterial elasticity. Phytochemicals may detoxify substances that cause cancer. They appear to neutralize free radicals, inhibit enzymes that activate carcinogens, and activate enzymes that detoxify carcinogens. They observed that, the Ocimum sanctum Linn has also been suggested to possess, anticancer, antidiabetic, anti-fertility, antifungal, antimicrobial, cardio protective, analgesic, antispasmodic and adaptogenic actions. Eugenol (1-hydroxy-2methoxy-4-allylbenzene) is the active constituents present in Ocimum sanctum Linn. Indian traditional shrub tulsi (Ocimum sanctums): They unique medicinal plant. They observed that, Ocimum sanctum heals many diseases chronically due to its chemical constituent and believes that it has anti- ageing, immunomodulatory property along with antimicrobial and anticancer property. Phytochemical analysis of aqueous extract of Ocimum sanctum. They observed that, the plant is known to possess antiseptic, analgesic, anti-inflammatory, antimicrobial, antistress, immunomodulatory, hypoglycemic, hypertensive and antioxidant properties. The dried powder of Tulsi (100g) was placed in the thimble of Soxhlet apparatus.500 ml of distilled water was used as a solvent.

Keywords: Ocimum sanctum Linn; Phytochemical analysis; Methanol extract; Antioxidant activity

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1) INTRODUCTION :

India is well known as an "Emporium of medicinal plants". It possesses about 8% of the estimated biodiversity of the world with around 12600 species and is one of the 12 mega biodiversity centers with 2 hot spots of biodiversity in the Western Ghats and North-eastern region . It's also rich in ethnic diversity, there are about 67.37 million tribal people belonging to 537 tribal groups living in different geographical locations with various subsistence patterns . These tribal groups living in diverse, rich areas possess a wealth of knowledge and skills on the utilization and conservation of food and medicinal plants . According to the World Health Organization (WHO), almost 65% of the world's population has incorporated the value of plants as a methodology of medicinal agents into their primary modality of health care. It is often noted that 25% of all drugs prescribed today come from plants . This estimate suggests that plant derived drugs make up a significant segment of natural product– based pharmaceuticals .

Plants have long been used by men for their basic needs especially Ocimum sanctum. In essence have been in practices of medicinal plants are deeply rooted in the society of indigenous community . Medicinal plants begins an important aspect of various traditional medicine systems, have been used therapeutically all around the world . Although the various systems of traditional medicine in the world, e.g., Ayurveda, Chinese traditional medicine, Unani, Tibetan Medicine , Amazonian or African Medicine, may be based on different theoretical and cultural models, they all integrate phytotherapy into their doctrine . According to World Health Organization (WHO) estimates, more than 80% of the people in developing countries depend on the traditional medicine for their countries depend on the traditional medicine for their primary health needs . It is generally estimated that over 6000 traditional plants

in India are used in folk and herbal medicine, representing about 75% of the medicinal needs of the 3rd world countries Aromatic plants possess odorous volatile substances which occur as essential oil, gumexudate, balsam and oleoresin in one or more parts, namely root, wood, bark, stem, foliage, flower and fruit. .The characteristic aroma is due to a variety of complex chemical compound. The essential oil is concomitant to fragrance or perfumes because these fragrance are oily in nature and they represent the essence or the active constituents of the plant . They are called volatile or ethereal oils as they evaporate when exposed to air at ordinary temperatures. Essential oils are highly concentrated, low volume, high value products. Application of essential oils in agriculture as antifeedants, repellents, botanical insecticides, natural herbicides and growth booster are still open to fascinating realms of research . Essential oils of only about 500 species are known in some detail at present. Of these about 50 species find use as commercial source of essential oils and aroma chemicals, through the number of those having regular and large scale utilization hardly exceeds two drones Phytochemicals (from the Greek word phyto, meaning plant) are biologically active, naturally occurring chemical compounds found in plants, which provide health benefits for humans further than those attributed to macronutrients and micronutrients. They protect plants from disease and damage and contribute to the plant's color, aroma and flavor. In general, the plant chemicals that protect plant cells from environmental hazards such as pollution, stress, drought, UV exposure and pathogenic attack are called as phytochemicals. Recently, it is clearly known that they have roles in the protection of human health, when their dietary intake is significant. More than 4,000 phytochemicals have been catalogued and are classified by protective function, physical characteristics and chemical characteristics and About 150 phytochemicals have been studied in detail. In wide-ranging dietary phytochemicals are found in fruits, vegetables, legumes, whole grains, nuts, seeds, fungi, herbs and spices.

Broccoli, cabbage, carrots, onions, garlic, whole wheat bread, tomatoes, grapes, cherries, strawberries, raspberries, beans, legumes, and soy foods are common sources. Phytochemicals accumulate in different parts of the plants, such as in the roots, stems, leaves, flowers, fruits or seeds. Many phytochemicals, particularly the pigment molecules, are often concentrated in the outer layers of the various plant tissues. Levels vary from plant to plant depending upon the variety, processing, cooking and growing condition. Phytochemicals are also available in supplementary forms, but evidence is lacking that they provide the same health benefits as dietary phytochemicals

2) REQUIRED PLANTS:-

2.1 TULASI

▪ Its scientific name of Tulsi is Ocimum tenuiflorum . It is grown in warm and tropical areas.Tulasi grows fragrantly, erect and with several branches.

▪ Types of tulasi

1.Krishna Tulsi (Brown color)

2. Rama Tulsi (Green color)

▪ Tulsi has a unique combination of actions that include: Antimicrobial (anti -oxidant, anti -cataract, anti -inflammatory, anti -pyretic, anti -allergic, anti - thyroid, anti -fertility, anti -ulcer properties

▪ Tulsi is enriched with various phytochemicals. The leaves of the plant contains volatile oil 71% eugenol and 20 % methyl eugenol.

▪ Tulsi contain antioxidants like beta carotene that help in preventing cell damage

2.2 BUTTERFLY PEA

Clitoria ternatea, commonly known as Butterfly pea

▪ This plant is native to equatorial Asia, including locations in south Asia and southeast Asia but has also been introduced to Africa, Australia and the Americas.

Different colors :-

1. White
2. Pink
3. Blue

▪ It contains antioxidants like (kaempferol, p-coumaric acid, delphinidin-3,5-glucoside).

▪ It's rich in antioxidants and often used as an herbal tea and natural dye.

3) EXTRACTION METHODOLOGY :-

Basically three types of extraction methods :-

- Extraction method
- Soaking method
- Ultrasonication

Extraction method :

Extracted using heat by Soxhlet apparatus and also soaking method

Soaking method:

Soaking (Tulsi ,butterfly pea)powder in solvent without using heat for long period

Ultrasonication

By ultrasound cavities, which leads to increase temperature and pressure which enhance extraction by breaking the cell walls .

3.1 Experimental procedure:

Using method :- extraction method & ultrasonic associated extraction .

Types : Tulsi & Butterfly pea

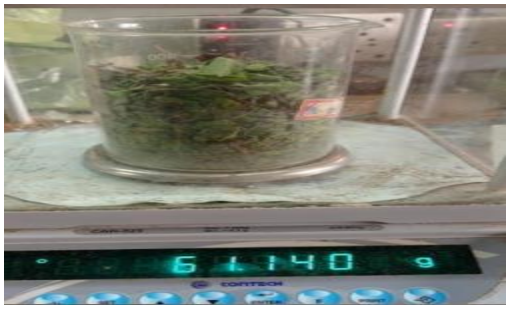
Portion requried : Leaves of Tulsii

Flower petals of butterfly pea

Apparatus : Soxhlet apparatus (condenser , distillation flask , sample holder , heater, round bottomed flask), ultrasonic cell crusher noise isolating chamber

Solvent used : Methanol , n hexane

1. First step in the experimental procedure is cleaning and it will done by collect fresh(Tulsi leaves OR Butterfly pea flowers) and wash them thoroughly with distilled water to remove any dirt.



2.Second step is drying the cleaned material and dry the leaves in a well-ventilated

area or in an oven at low temperature (below 50°C) until they are completely dry

3.Third step is size reduction grind the dried leaves using a mortar and pestle to obtain a fine powder.

3.2 By using soaking method :-

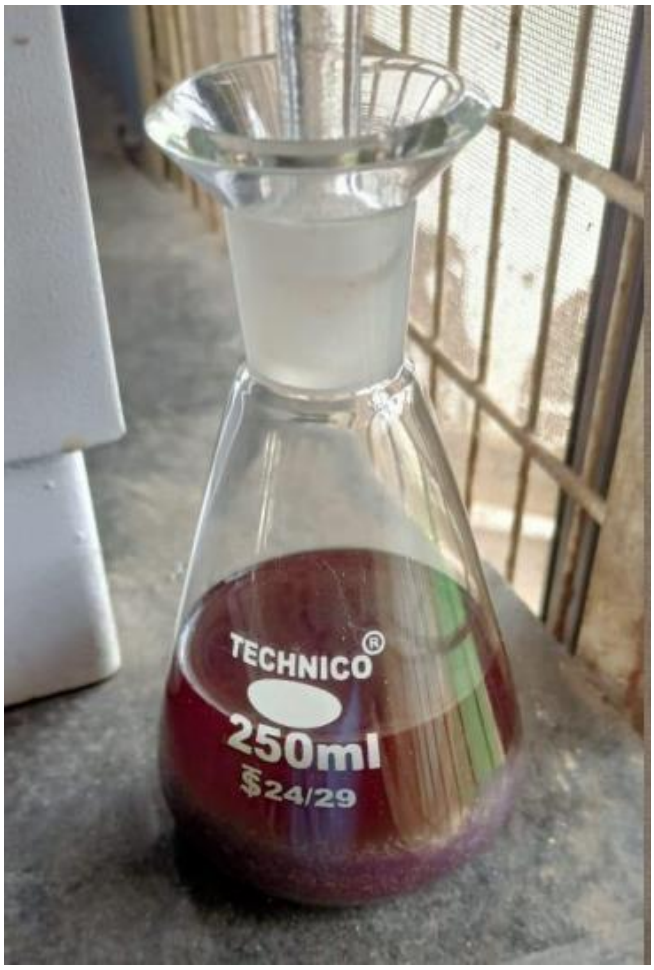
• Weight out about 25 g of the powdered Tulsi leaves OR Butterfly pea leaves and place them in a beaker or flask.

• Add 50 mL of ethanol or methanol to the beaker or flask and stir the mixture thoroughly.

• Cover the beaker or flask with aluminum foil to prevent evaporation and place it in a dark place for 24 hours to allow for the extraction of antioxidants.

• After 24 hours, filter the mixture through filter paper to obtain a clear extract.

• Evaporate the solvent from the extract to form the product



Soaking method

3.3 solvent extraction method :-

• 25 grams of powder should be wrapped in the Whatman filter paper. Insert the wrapped material in the extraction chamber .

• Add appropriate solvent to cover it in the extraction chamber. Assemble the distillation apparatus, ensuring that the condenser is securely attached to the distillation flask.

• Make sure to run the condenser with running cool water to keep it cool during the distillation process. Heat the distillation flask slowly and steadily using a heating source.

• Allow the distillation process to continue until enough antioxidant-rich solvent has been collected in the receiving flask.

• Turn off the heating source and allow the apparatus to cool. Once cooled, carefully

remove the receiving flask and evaporate the excess solvent to obtain the product

Efficiency of soxhlet extraction for both plants :-

Antioxidants from Tulsi by Soxhlet extraction:

Efficiency = (3/25)*100 = 12%

Antioxidants from butterfly pea by Soxhlet extraction:

efficiency = (4/25)*100 = 16%

4) Identification of anti oxidants :

4.1 DPPH METHOD

There are several methods to identify the antioxidants, in those, one method is "DPPH"

• DPPH stands for 2,2-diphenyl-1-picrylhydrazyl, which is a chemical compound commonly used as a reagent to measure the antioxidant activity of substances. It is a stable free radical that reacts with antioxidants by giving up an electron, resulting in the formation of a stable diamagnetic molecule.

• When DPPH comes into contact with an antioxidant, such as a phenolic compound, the antioxidant donates an electron or hydrogen atom to the DPPH radical, causing the radical to be reduced and change color from purple to yellow.

• The change in color can be measured spectrophotometrically, to find the concentration of the antioxidants

• This method is used to determine the antioxidant potential of various samples, including food extracts, plant extracts, and pharmaceutical compounds.

Preparation of "DPPH"

• It is present in the solid form , it is prepared by using solvent methanol

• The standard solution for preparing of the DPPH is by adding 24mg in 100l of methanol.

• DPPH (violet) +antioxidant pale yellow/colorless

4.2 Photometric analysis :

This analysis is done to know the concentration of the antioxidants present in the product sample

• Photometric analysis is a technique used in various scientific fields to measure the intensity of light emitted, absorbed, or transmitted by a sample. It is widely used to determine the concentration of substances or to study various optical phenomena.

• The principal of photometric analysis is based on the measurement of light intensity using a photometer or spectrophotometer.

Procedure:

• Take 1ml of product sample and makeup with the appropriate solvent (methanol) to make into 10ml solution in a volumetric flask , it is considered as 1st main solution

• Now Take approximately 1ml from the 1st main solution and makeup to 10ml in volumetric flask .

• By using as a solvent (methanol) as a reference, find out the absorbance value by setting an appropriate wavelength (517 nm)

5) RESULTS :

5.1 YEILD :-

For tulasi :

SNO	Method	Yield (ML)	Efficiency
1	Soaking method	4 ml	16%
2	Soxhlet extraction	3 ml	12%
3	Ultrasonic associated extract	3 ml	12%

For butterfly pea :

SNO	METHOD	YIELD (ML)	Efficiency
1	Soaking method	5 ml	20%
2	Soxhlet extraction	4 ml	24%
3	Ultrasonic associated extract	6 ml	16%

5.2)CONCENTRATION OF SUBSTANCES :

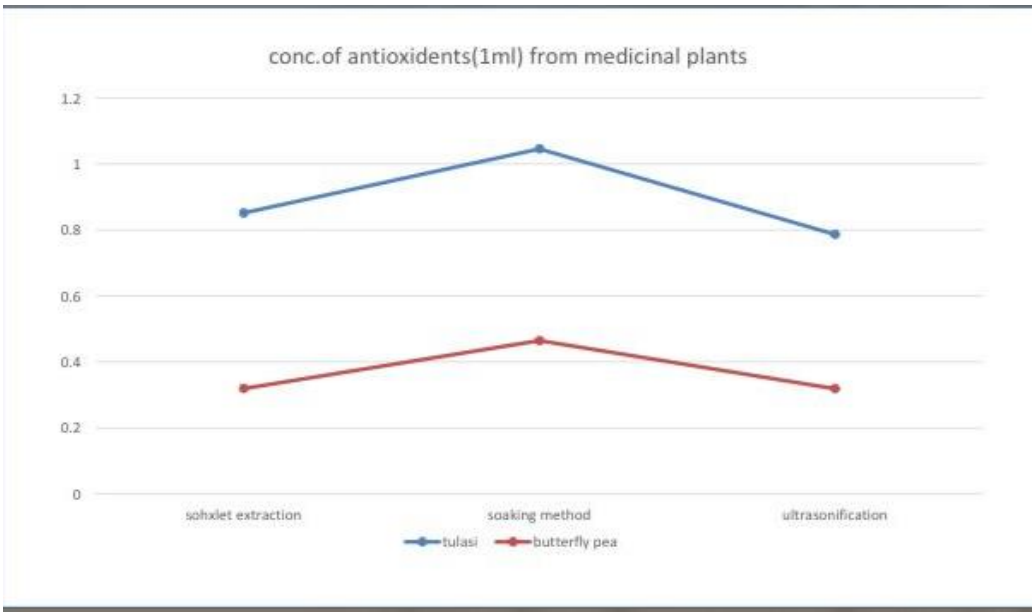
	Soxhlet extraction		Soaking		Ultrasonification	
	Abs	concentration	Abs	concentration	Abs	concentration
Tulasi	0.5704	0.8514	0.8419	1.0564	0.4086	0.7865
Butterfly pea	0.1570	0.3195	0.1892	0.4646	0.1564	0.3187

Sample calculation :

For Abs = 0.1564 ,

Concentration = $\left(\frac{0.1564}{715}\right) * 10 * 100$ = 0.3187 mg/ml

Graph for concentration :



6) APPLICATIONS OF ANTIOXIDANTS :-

Antioxidant supplements are compounds obtained either by extraction from natural foods or by chemical synthesis. Of course, they do not have the same composition as natural antioxidants in foods. Therefore, opinions are divided over whether or not antioxidant supplements offer the same health benefits as antioxidants in foods. So some of the benefits are below :-

6.1) applications of tulasi :

Skin health: They can help to protect the skin from damage caused by UV radiation, pollution, and other environmental stressors.

Immune system support: They can help to boost the immune system by neutralizing free radicals and reducing inflammation.

Respiratory health: They show anti-inflammatory properties that can help to reduce symptoms of respiratory conditions like asthma and bronchitis.

Digestive health: They reduce inflammation in the gut and protect against damage caused by free radicals. This can help to improve digestion and reduce symptoms of digestive disorders like ulcerative colitis.

Cardiovascular health: They can help to protect against oxidative stress, which can damage the cells lining blood vessels and increase the risk of heart disease.

6.2) applications of butterfly pea

Anti-aging benefits: They help to protect the skin from damage caused by free radicals, which can contribute to aging.

Brain health: They have been shown to have neuroprotective effects, which may help to reduce the risk of cognitive decline and improve memory and learning abilities

Stress and anxiety: They contains anxiolytic properties, which can help to reduce stress and anxiety levels.

Eye health: They may help to protect the eyes from damage caused by free radicals, which can contribute to the development of eye diseases such as cataracts and macular degeneration.

Diabetes management: They have been shown to help regulate blood sugar levels,

making it a potential natural treatment for diabetes.

Cardiovascular health: They may help to reduce inflammation and improve blood flow, which can have a positive effect on cardiovascular health.

7) CONCLUSION :

Tulasi and butterfly pea are the medicinal plants what we choose for the experiment. Tulsi is also known as "the elixir of life" since it promotes longevity. Different parts of plant are used in Ayurveda and Siddha Systems of Medicine for prevention and cure of many illnesses and everyday ailments like common cold, headache, cough, flu, earache, fever, colic pain, sore throat, bronchitis, asthma, hepatic diseases, malaria fever, as an antidote for snake bite and scorpion sting, flatulence, migraine headaches, fatigue, skin diseases, wound, insomnia, arthritis, digestive disorders, night blindness, diarrhea and influenza. This review will definitely help for the researchers as well as clinicians dealing with Ocimum sanctum to know its proper usage as this herb is seemed to be highly valuable, possessing many pharmacological/ medicinal properties. In conclusion, the present study phytochemical screening, total phenolic contents, total flavonoids contents and antioxidant properties have been done using Ocimum sanctum plant of methanol extracts. Among the two extract, the methanol was found to be the best extract the antioxidant.

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A

FIELD PROJECT

REPORT

ON

EXTRACTION OF CAFFEINE FROM COFFEE SEEDS AND ITS APLLICATION

Submitted in the partial fulfillment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

In

Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

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UNDERTAKING

This is to declare that the field project entitled "EXTRACTION OF CAFFEINE FROM COFFEE SEEDS AND ITS APPLICATIONS" is an original work done by undersigned, in partial fulfillment of the requirements for the degree "Bachelor of Technology in Chemical Engineering.

All the analysis, design and system development have been accomplished by the undersigned. Moreover, this project has not been submitted to any other college or university.

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Estd. u/s 3 of UGC Act 1956

CERTIFICATE

This is to certify that the field project entitled as, "**EXTRACTION OF CAFFEINE FROM COFFEE SEEDS AND ITS APPLICATIONS**" submitted by 201FA02004, 211LA02011, 201FA02012, 201FA17005 to the Vignan's Foundation for Science, Technology and Research (Deemed to be) University, Guntur, Andhra Pradesh for the award of the degree of Bachelor of Technology is a bonafide record of the research work done by him/her under my supervision. The contents of this thesis, in full or in part, have not been submitted to any other institute or university for the award of any Degree.

Project Guide

(Head of the Department)

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FOR SCIENCE, TECHNOLOGY & RESEARCH
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ABSTRACT

This paper focuses upon extraction of a natural product, caffeine, from Coffee. It has been chosen since the starting ingredients are relatively easy to come by, and we will still find a reasonable level of challenge. Caffeine is a natural product found in coffee and tea. Efficient extraction of caffeine from Coffee relies heavily on the properties of caffeine & other components present in Coffee. This work will focus upon procedure (Batch) for Caffeine extraction and their working principles, its design aspect, various analytical methods for its separation/detection. It is to be noted that its scale up can be done according to industrial demand for its usage for manufacturing other products. By using Caffeine as raw material, we will prepare an Anacin – a pharmaceutical product which has several medicinal uses.

Keywords: Caffeine, Anacin, pharmaceutical.

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INTRODUCTION:

Coffee is one of the most consumed beverages in the world and, after petroleum, is the second traded product worldwide. In Western countries, a significant portion of the daily beverage is constituted by the different varieties of coffee. Coffee grows mainly in Africa and South America and nowadays, among many known species, only two varieties are successfully used in commercial cultivation: Coffea arabica var. Arabica and Coffea canephore var. Robusta. Arabica is mainly cultivated in Brazil, Colombia, Costa Rica, Guatemala and India, whereas Robusta is mainly cultivated in Vietnam, Ivory Coast, Guatemala and India.

Coffee is second only to water as the most widely consumed beverage in the US and Europe and it is the main source of caffeine in daily consumption in adults, even if caffeine is contained also in tea, chocolate, and soft drinks. The two coffee bean varieties of worldwide importance differ considerably in price, quality and consumers' acceptance. Indeed, Arabica is preferable for the aroma effect and Robusta for taste and body; for these reasons, a good flavor is commonly obtained by blending the two varieties. Moreover, caffeine content of green coffee beans varies according to the species: Arabica beans contain about 1.0–1.2%, whereas the caffeine content in Robusta beans is about 1.6–2.5%.

Even if a moderate consumption of caffeine can have beneficial effects on adults' behavior, numerous studies, in recent years, reported the effect of caffeine consumption on cardiovascular diseases and on central nervous system, leading to an increasing consumption of decaffeinated coffee. Moreover, caffeine recovery is important, because it can be used in cola-type drinks or in combination with other active principles in the pharmaceutical field (in the treatment of headache and neuralgia), or as an ingredient in the cosmetic field (in the treatment of cellulitis and localized excess fat).

Four main methods are used worldwide for the decaffeination: in the solvent based methods, organic solvents (mainly methylene chloride and ethyl acetate) are employed, whereas in the

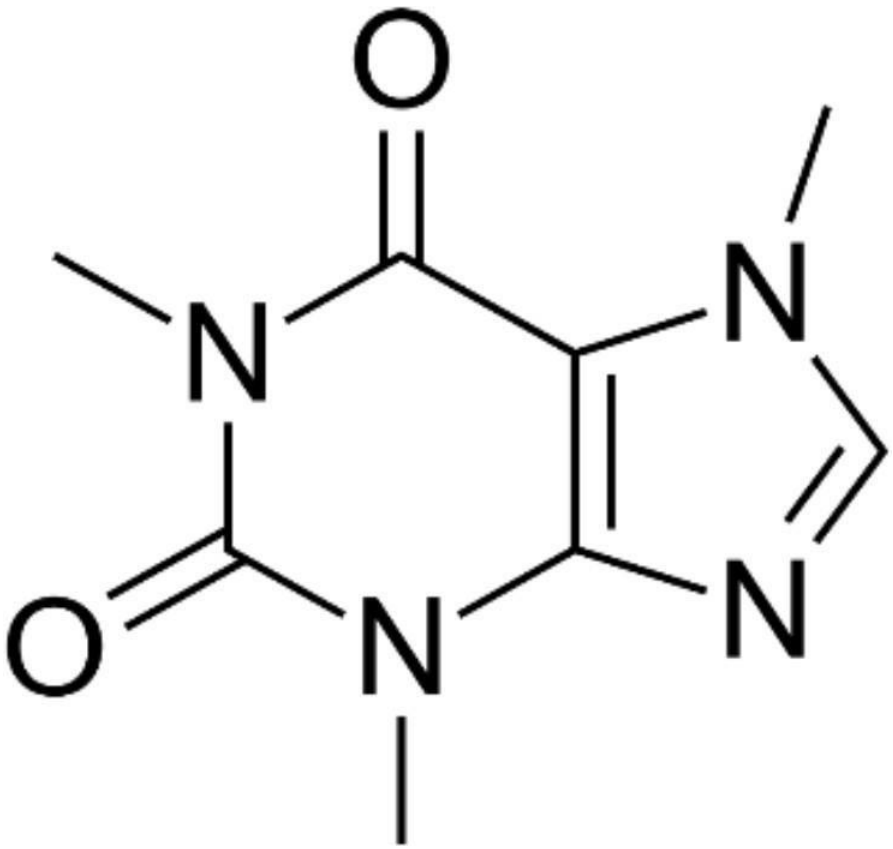
non-solvent based methods, water or supercritical carbon dioxide (scCO2) are used for the caffeine extraction. In all cases, coffee is decaffeinated in its green state; i.e., before the roasting operation. Until the mid-1970s, methylene chloride was considered the best solvent for extraction of caffeine with satisfactory results. However, subsequently, doubts arose about its risk to humans, due to the solvent high toxicity. Although the residual amount of methylene chloride in decaffeinated coffee was well below the limit of 10 ppm, established by the Food and Drug Administration, the suspected carcinogenicity of this solvent led to the choice of a less toxic solvent, such as ethyl acetate, a natural component detected in coffee aroma and found to occur naturally in different fruits. The use of ethyl acetate has two considerable drawbacks: it is highly flammable and has a fruity aroma. It must be handled carefully, increasing production costs, and it tends to pass on its characteristic aroma to the coffee, slightly altering the flavor. The decaffeination using water was developed in Switzerland, and constitutes a green process with respect to the product. Unfortunately, water is not a particularly selective solvent and, therefore, not only caffeine but also various flavors were removed from coffee beans using this method. As a result, a less flavorful brew with respect to other methods was obtained. The most selective process for removing just caffeine and not the other flavor precursors from coffee is based on the use of scCO2. This process was successfully developed on an industrial scale in the 1970s, based on two patents developed by Zosel: in the first one, the process was presented for the recovery of caffeine, whereas, in the second one, a detailed description aimed at obtaining decaffeinated coffee was proposed. Supercritical fluids (SCFs) based techniques were proposed as an alternative to conventional processes, thanks to their specific characteristics, mainly, solvent power and liquid-like densities with gas-like transport properties that can be tuned by varying pressure and temperature. They were successfully applied in several fields, such as, for example, micronization, porous structures formation, adsorption. Among the different scCO2 based processes, one of the most studied one was supercritical fluids extraction (SFE), for the possibility of continuously modulating the solvent power/selectivity; this process was frequently used for the extraction of essential oils. SFE was used also for the extraction of caffeine from natural sources, such as coffee husks, coffee beans and tea leaves.

1. literature review

1.1Coffee

coffee the known evidence of coffee, knowledge and usage, dates to the 15th century. Ethiopian and Yemen cultures have cited the use of coffee in the 14th and 15th centuries. The beans obtained from the coffee shrub were used by the people to brew a concoction that energized them and helped them improve their concentration. The drink later reached Europe in the 17th century travelling through Cairo, the Middle East and Constantinople, where it became an instant hit among the people for its exquisite taste and aroma. Coffee comes from plants belonging to the genus Coffea. The two commercially important species are Arabica and Robusta out of the nearly 100 species that are estimated to exist. The optimum conditions required for these trees grow best include rich soil, mild temperatures, frequent rain and shaded sun. The coffee beans go through a series of steps between when they are planted and brewed to make a cup of coffee. These steps typically involve planting the shrubs, harvesting the cherries, processing them, drying the beans, milling them, roasting the coffee beans, grinding them and finally brewing the coffee. The caffeine in coffee has a lot of benefits when consumed by healthy adults within the daily-intake limit prescribed, which is generally about 400 mg, though it varies from person-to-person. The benefits include boosting metabolic rate, improving physical performance, providing essential nutrients like Riboflavin, Manganese, Magnesium, Potassium, Niacin, etc. Coffee has also been seen to reduce the risk of type II diabetes, Alzheimer's disease, Parkinson's disease and dementia among drinkers. Coffee also has a lot of antioxidants, thus reducing the risk of cancer. The caffeine content in coffee depends upon the specific type of bean being used.

1.2 Caffeine



Caffeine is an alkaloid (1,3,7-trimethylxanthine) and occurs naturally in tea leaves and coffee beans. Cocoa beans, from which chocolates are made, also contain a caffeine-like compound. It is the world's most consumed psychoactive drug. It is also artificially added to many types of sodas and energy drinks. This is because of how caffeine stimulates the Central Nervous System and keeps people alert and prevents tiredness. When consumed, 99% caffeine is absorbed into the bloodstream. It is lipophilic and crosses all biological barriers and is supplied to all body tissues. It also crosses the blood-brain barrier and the placenta.[8] It has been speculated that caffeine causes risk of heart diseases among its takers but there is no conclusive evidence of this. However, animal studies have indicated that it might be a weak teratogen (an agent that causes birth defects in an embryo or fetus), so pregnant women are advised to limit their intake of caffeinated beverages.

1.3. Effects of caffeine on body

Caffeine is probably the most frequently ingested pharmacologically active substance in the world. When consumed at regular intervals, the body develops tolerance for caffeine and this depends upon the amount of consumed by individuals. Once accustomed to a particular amount, a cut down in the intake leads to caffeine withdrawal syndrome. The symptoms include headache, nausea, anxiety, restlessness and the intense urge to drink coffee. It interacts with various systems of the body and has the following results:

Central Nervous System: •There is increase in vigilance and arousal when coffee is consumed. •Ingesting caffeine before sleep has shown increase in sleep latency, reduction in total sleeping time and an overall poorer quality of sleep.

Cardiovascular Effects: •In hyper-tension prone drinkers, acute intake of caffeine has shown an increase in blood pressure. However, long term consumption has shown the development of tolerance and thus, no effect on blood pressure in the longer run.

Respiratory Effects: •A primary increase in the respiratory rate can be observed and this is directly proportional to the plasma-caffeine level. •In patients with asthma, caffeine acts as a bronchodilator.

1 Material & Methods

1.1 Required seeds

Coffee is one of the most traded commodities, and is one of the most popular drinks in the world due to its unique flavor and characteristics. Two major species of coffee grown commercially are Robusta and Arabica. Robusta seeds were chosen because it has more content of caffeine 2kgs of Robusta coffee beans were bought an were performed required experimentation

1.2 Methods of caffeine extraction

solvent	Solubility in water	Boiling point, C	Density (g/ml)
Ethyl acetate	Fairly soluble	76	0.902
Acetone	Fairly soluble	56	0.791

Sl.no	Decaffeination method	description
1	**water**	Non- toxic, complex process, remove little flavoring components
2	**Ethyl acetate**	Removes caffeine and little flavor compounds. Mildly toxic, removes some flavoring compounds.
3	**Dichloromethane**	Removes caffeine and little flavor compounds. Highly toxic, removes some flavoring compounds
4	**Supercritical CO2**	Selectively removes caffeine and very little flavor compounds, expensive

1.3 Process of Extraction of caffeine

1.3.1 Soxhlet extraction

1. Take the coffee beans and crush as small as possible
2. After crushing collect the powder form of coffee
3. Put the required amount of coffee powder into Soxhlet apparatus
4. Add the required amount of solvent either Acetone or Ethyl acetate into to the Soxhlet apparatus.
5. Start heater for heating purpose and maintain the temperature
6. After prescribe time, collect the mixture and filtrate it by using filter paper for separating the solid content.

7. Put the liquid mixture into simple distillation apparatus for recover the solvent, so collect sample
8. Finally, samples are carried for analysis in GC Capillary column
9. Caffeine can further be gotten into powder form by putting the solution into the sublimator assembly as shown below

The equipment used for the caffeine extraction is sublimator and separating funnel

1.3.2 Powder based extraction

1.3.2.1 First take coffee beans of weight 200gms and make a fine powder of coffee beans by using mixer.

1.3.2.2 By using sieve analysis separate the coarse particles from the mixture

1.3.2.3 Now weigh 200gms of powder and take it into the 500ml beaker.

1.3.2.4 Add sodium carbonate of 60gms to the mixture this compound is added to the mixture because to increase the solubility of the caffeine.

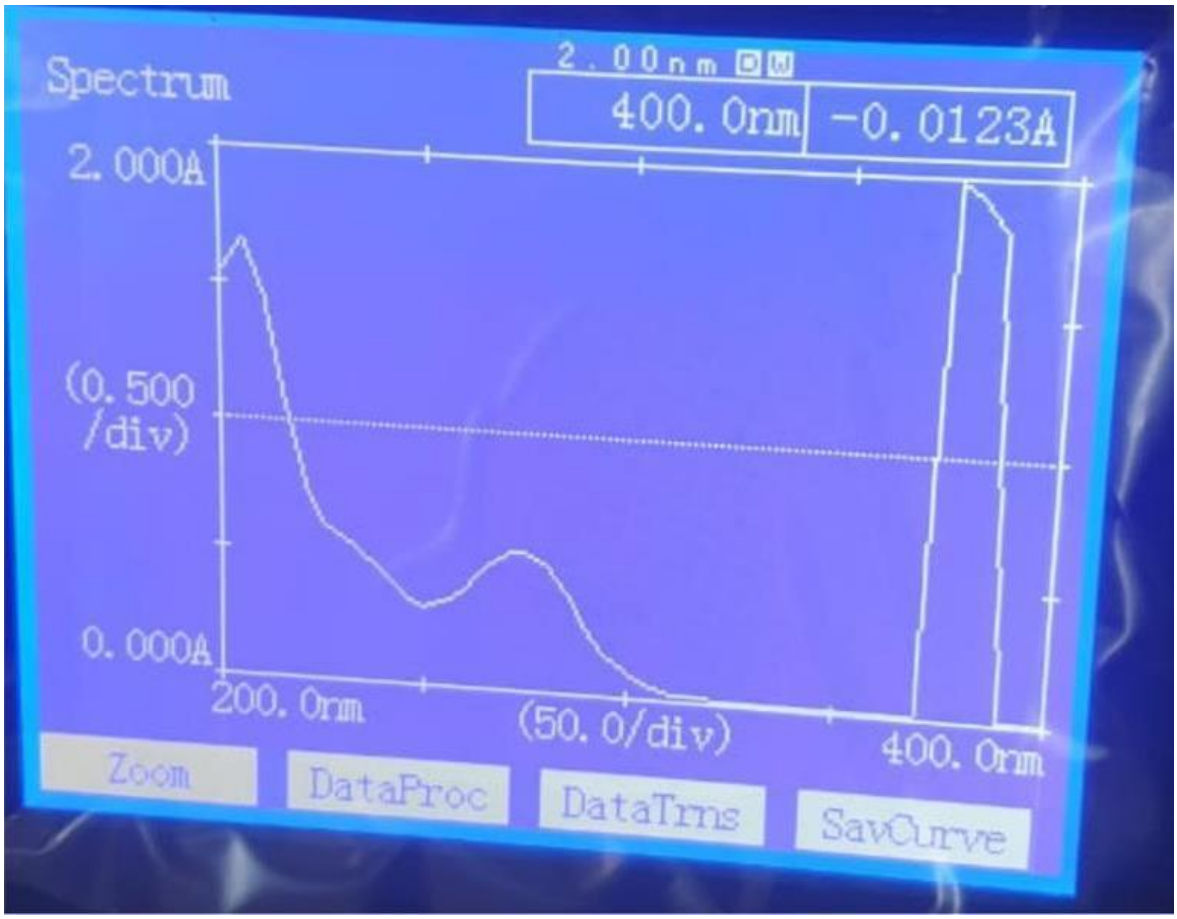
1.3.2.5 Water content of 400ml was added in a ratio of (1:2) ratio and was mixed thoroughly and was let to evaporation by application of heat (80C)

1.3.2.6 The liquid mixture was allowed to come until the 200ml mark so that liquid gets highly concentrated with caffeine.

1.3.2.7 Next we take mixture into the separating funnel and add the solvent and is left for 12 hrs and a layer gets separated by removing the bottom layer that is mixture of caffeine and evaporation is done to extract caffeine

2 IDENTIFICATION

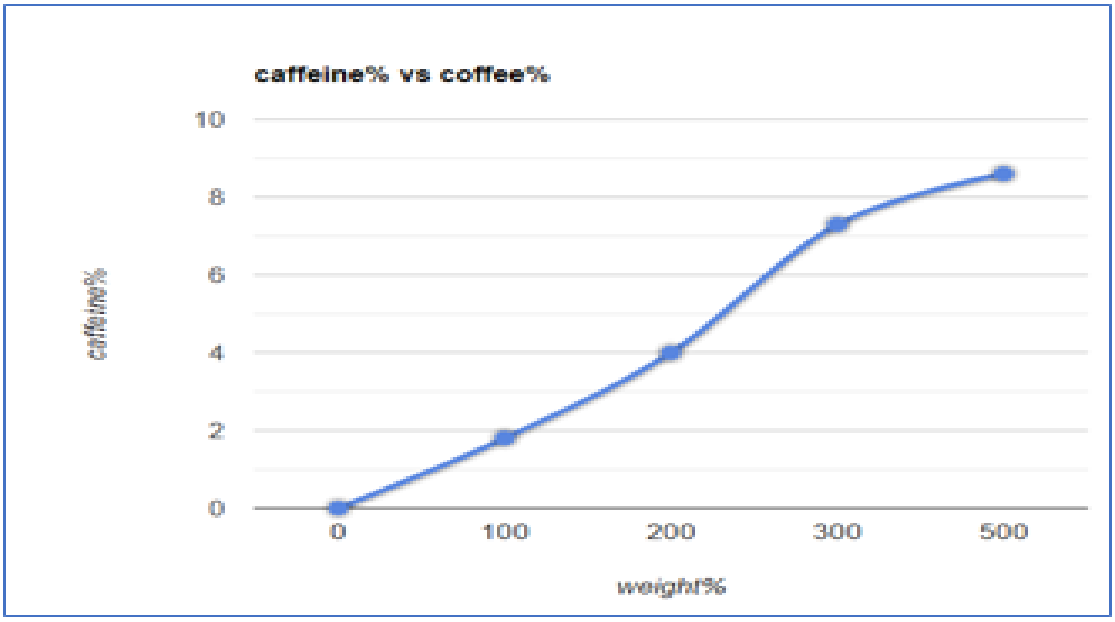
In this the extracted caffeine was sent to the spectrometer UV analysis from this the wave length was obtained 274nm. When compared to the literature survey we found that caffeine should be of 260 to 275nm.



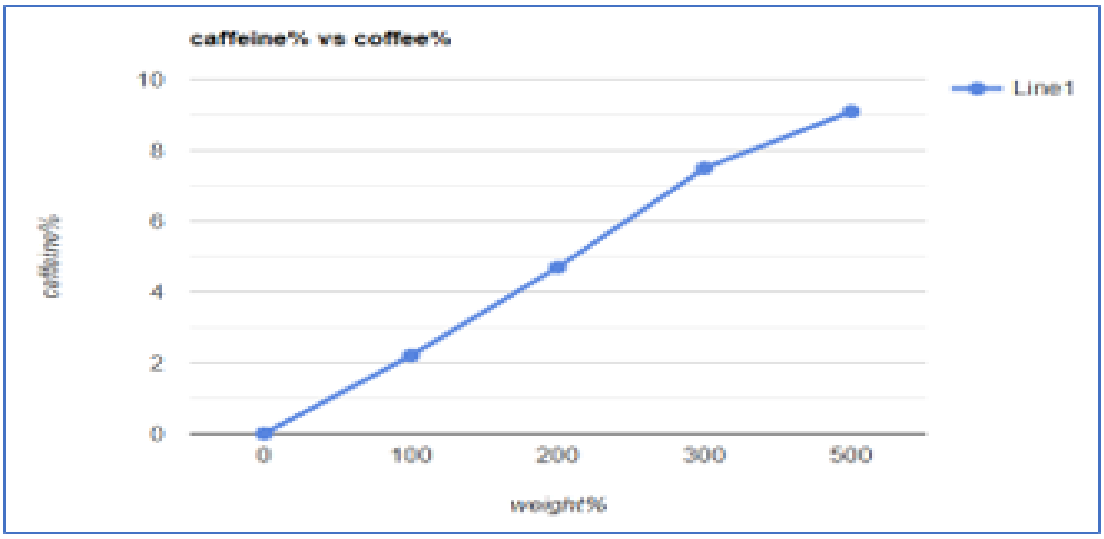
In this spectrometer first we should take a solvent for cleaning and next the caffeine should be dissolved into in the 100ml solution with a weight of 100mg so that the liquid contains 1mg/1ml. Next the standard solution was prepared with dissolving the 10 ml of this solution to the 100ml distilled water and then we prepare work solution which comprises of 0.01mg/1ml which is used for the UV spectrometer this test helps us to know about the compound is correct or wrong product is obtained.

3 Yield analysis:

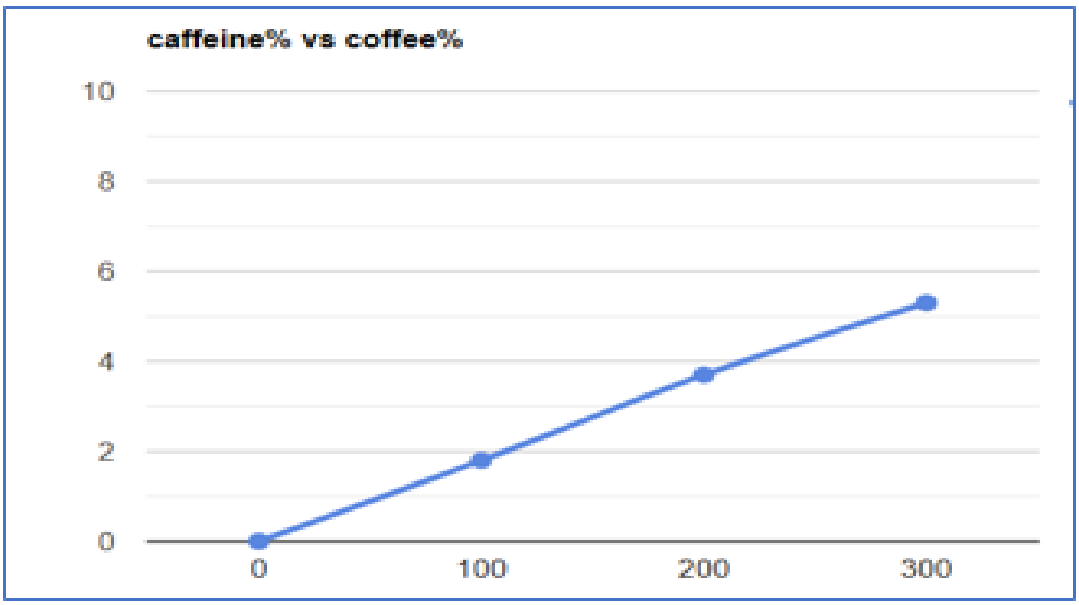
When caffeine was extracted yield ratio should also be checked for better experimentation the following diagrams explains the weight of coffee powder to the amount caffeine was extracted



The above graph explains about the yield obtained for the coffee powder to the solvent acetone (gm vs gm)



The above graph explains about the yield obtained for the coffee powder to the solvent ethyl acetate (gm vs gm)



The above graph explains about the yield obtained for the coffee powder to the solvent water (gm vs gm)

4 Drug powder preparation

1. Initial preparation of starch mucilage (5% v/v):

In 10 mL of water, disperse 1 g of starch powder in a beaker. Take another 10 mL of water in another beaker and keep for heating. When the temperature is raised to 60 – 65oC, add the starch dispersion from the first beaker to the water under heating. Mix it continuously until the formation of a sticky viscous solution. Then remove from heating and allow to cool to room temperature

2. preparation of tablets:

Pass the all the excipients through sieve #80. According to the formula given in the table, weigh specified quantities of Aspirin and other excipients. Transfer Aspirin, lactose and starch into a clean and dry mortar and mix thoroughly. Now add starch mucilage drop-wise to the powder and mix. Continue the addition and starch mucilage and mixing until

formation of dough mass. Now take a clean and dry sieve no 12 and pass small amounts of the dough mass through the sieve to obtain wet granules. Keep these granules in a hot air oven at 60oC until dried sufficiently. After drying, remove the granules from the hot air oven and check the weight of dried granules. Add proportional quantities of lubricant and other extra-granular excipients to the obtained dry granules in a polythene bag and mix for 3min. Compress these lubricated granules in a tablet compression machine to obtain tablets of 300 mg each.

s.no	ingredient	Quantity per 1 tablet (mg)	Quantity per 20 tablets
1	Aspirin	400	2 gm
2	Caffeine	32	640 mg
3	Starch mucilage	Q.S	

5 Gel preparation:

5.1 definition:

A gel is a solid or semisolid system of at least two constituents, consisting of a condensed mass enclosing and interpenetrated by a liquid

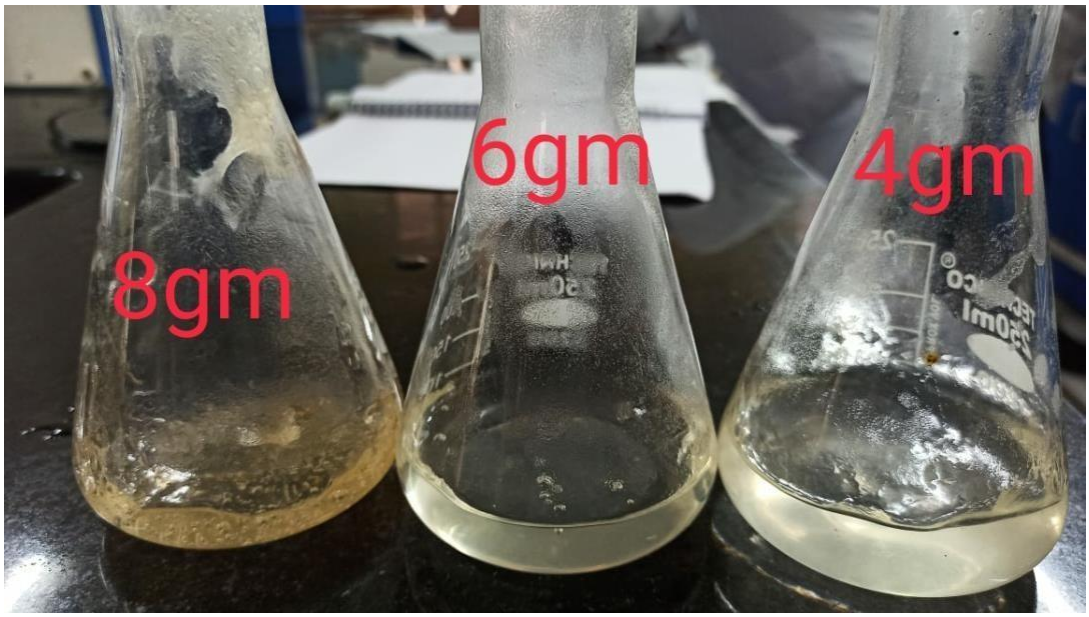
5.2 Preparation of gels

The gel can be prepared in 3 different types of method they are

1. Cold method
2. Fusion method
3. Dispersion method

In this case dispersion method was chosen since it was the most effective and efficient it includes the stirring the gelling agent at 1200rpm for 30 minutes

The gel was prepared by using mortar and pestle and using the chemicals carboxy methyl cellouse which is a semi synthetic polymer was used as gelling agent. In this



process three samples were taken which are 4, 6, 8 grams respectively into conical flask. Here the three samples were taken to adjust the viscosity according the patient satisfaction. At first the extracted caffeine was taken which is 5gm in each beaker was dissolved in the distilled water and was added with CMC and was kept in shaker 30 minutes at 1200 rpm.

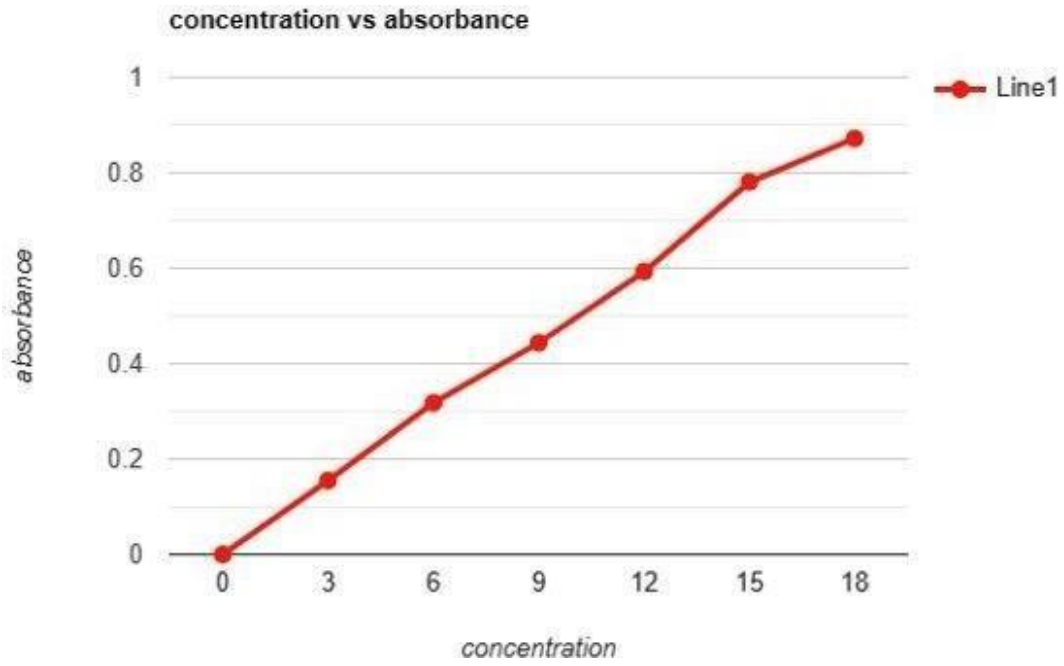
6 Results and conclusion

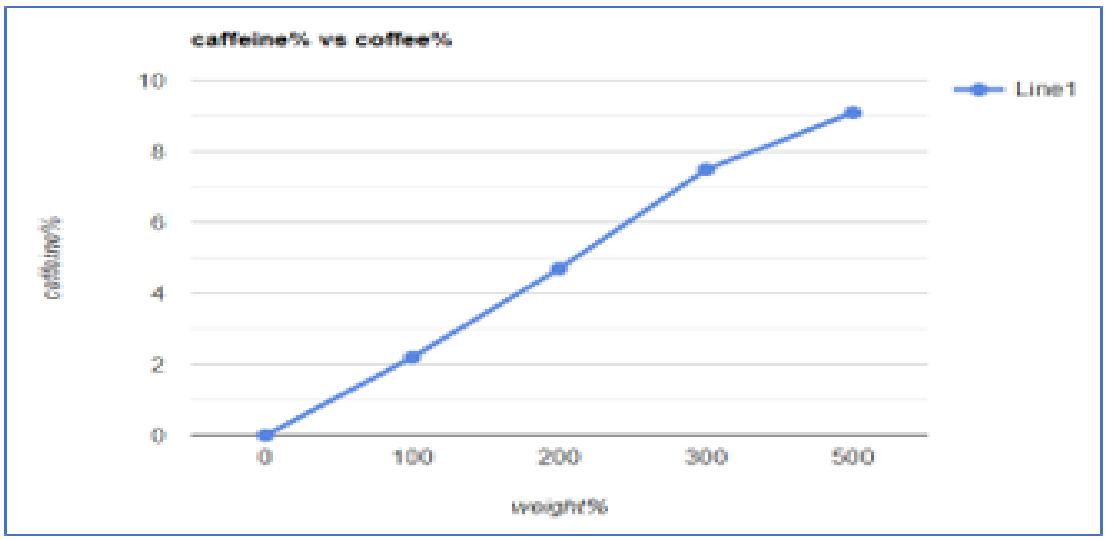
The total caffeine obtained is mentioned in the following table

Sl.no	Solvent used	Weight of coffee beans used (kg)	Weight of caffeine extracted (gm)
1	Acetone	1.1	20.7
2	Ethyl acetate	1.1	22
3	water	0.6	10.5

As we can see, the highest amount caffeine can be extracted by using ethyl acetate.

The absorbance test was conducted to know the light absorbance so that we can know the penetration of the drug molecule. The results are as follows





The above graph explains the amount caffeine extracted to the amount of coffee beans used Units of (gm vs gm).

Conclusion:

Caffeine is a natural stimulant found in coffee, tea, chocolate, and other food and drinks. Caffeine is defined as a drug because it stimulates the central nervous system. It affects kids and adults similarly and, at lower levels, can make people feel more alert and energetic. Foods and drinks with caffeine are everywhere, but it's wise to keep caffeine consumption to a minimum, especially in younger kids. From the result of the performed experiment, it can be concluded that coffee and caffeine lead to an increase in the natural acidity of the stomach. This is because caffeine has a direct effect on the gastric acid and pepsin secretion. This, in the long run, can lead to peptic ulcers in regular drinkers. This effect is predominant when coffee is ingested into an empty stomach and leads to acute heartburn

7 References:

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https://www.academia.edu/69528114/Extraction_of_caffeine_from_Robusta_coffee_Coffea_canephora_var_Robusta_husks_using_supercritical_carbon_dioxide

https://www.academia.edu/27112645/EXTRACTION_OF_CAFFEINE_CHLOROGENIC_ACIDS_AND_LIPIDS_FROM_GREEN_COFFEE_BEANS_USING_SUPERCRITICAL_CARBON_DIOXIDE_AND_CO_SOLVENTS

https://doi.org/10.1111/1750-3841.14060

A

FIELD PROJECT

REPORT

ON

"SYNTHESIS OF LOW COST BIO ETHANOL FROM ROTTEN TOMATOES"

Submitted in the partial fulfillment of the requirements for the award of the degree
BACHELOR OF TECHNOLOGY

In
Department of Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

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MAY :- 2023

UNDERTAKING

This is to declare that the FIELD project entitled **"SYNTHESIS OF LOW-COST BIO-ETHANOL FROM ROTTEN TOMATOES"** is an original work done by the undersigned, in partial fulfillment of the requirements for the degree "Bachelor of Technology" from the Department of Chemical Engineering, All the analysis, design, and system development have been accomplished by the undersigned. Moreover, this project has not been submitted to any other college or university.

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-Estd. u/s 3 of UGC Act 1956

CERTIFICATE

This is to certify that the field project entitled as, "**SYNTHESIS OF LOW COST BIO ETHANOL FROM ROTTEN TOMATOES"** submitted by 201FA02008, 211LA02004, 201FA02010, 211LA02005 to the Vignan's Foundation for Science, Technology and Research (Deemed to be) University, Guntur, Andhra Pradesh for the award of the degree of Bachelor of Technology is a bonafide record of the research work done by him/her under my supervision. The contents of this thesis, in full or in part, have not been submitted to any other institute or university for the award of any Degree.

B. S. Latha
Project Guide

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ABSTRACT

This research was carried out to produce bio-ethanol by batch fermentation of solanum tuberosum (tomato), The rotten tomatoes were used in the study. Saccharomyces cerevisiae (baker's yeast) was used with KMnO4, and sucrose, for fermentation. Bio-ethanol concentration was measured using a hydrometer and its physicochemical properties were determined by standard methods. Bio-ethanol is a renewable energy resource, as the resources of fossil fuels are now decreasing. To meet the needs of fuels bio-ethanol is a required source. As bio-ethanol reduces greenhouse gas emissions and contributes to a greener future. All the selected overripe tomatoes were analyzed for variations in parameters including specific gravity, pH, temperature, and concentration during complete fermentation for bio-ethanol production. After complete fermentation, it was clear that the specific gravity is. The FTIR curve of each sample shows an absorbance peak in a wave number range of 3000 cm−1 to 3500cm−1, which indicates the absence of alcohol in the samples after fermentation.

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3. **METHODOLOGY**
4. **IDENTIFICATION**
5. **RESULTS & DISCUSSIONS**
6. **APPLICATIONS**
7. **CONCLUSION**
8. **REFERENCES**

1. INTRODUCTION :

A wide range of organic chemicals are produced commercially via fermentation using different microorganisms. Though ethanol is conventionally produced from petroleum by-products, bio ethanol can alternatively be produced by fermentation technology using renewable raw material (rotten tomatoes). The tomato contain valuable components such as sucrose, glucose, fructose, and other nutrients. India is one of the largest producers of tomatoes in the world, with a production of around 20 million metric tons in 2020. However, along with the high production, there is also a significant amount of waste generated during the production and distribution processes.

According to a study by the Central Institute of Post-Harvest Engineering and Technology (CIPHET), around 16-18% of tomatoes produced in India are wasted due to improper handling and storage practices. This amounts to approximately 3.2-3.6 million metric tons of tomatoes being wasted every year. As the wastage of tomatoes is generated highly, these wasted tomatoes are used for the production of bioethanol and biochar in this study.

The industrial production of bioethanol via traditional chemical methods involves the reaction between ethylene and steam at high pressure in the presence of extreme temperatures. This process has various adverse effects on the environment. Biofuels are emerging worldwide as an alternative because of their industrial and economic value. They pose no threat to the environment, thus helping to reduce greenhouse gases and provide energy security, which is leading to their growing use.

The production of biofuels using biomass from microalgae or other waste represents an important effort to save nature and the environment which are being exploited by using harmful chemical substances around the bio-ethanol and has long been considered as a suitable alternative to fossil fuels. Moreover, bio-ethanol is not a petroleum product and can be easily synthesized via agricultural feedstock or fruit waste, which makes it a suitable industrial chemical. Bioethanol production has been realized from various raw materials such as sugar cane, wheat, and corn. Instead, organic solid waste (over ripped tomatoes) is considered to be a good often due to its low cost, and great availability. Fermentation of ethanol converts sugar into cellular energy and produces ethanol and CO, as end products. The alcoholic fermentation converts 1 mol of glucose into 2 mol of ethanol and

2 mol of carbon dioxide, producing 2 mol of ATP in the process ($C_6H_{12}O_6$, $2C_2H_5OH+2CO_2$) (Baskar et al. 2012) Ethanol (CH_3CH_2OH), also known as bio-ethanol.

There is certainly an industry addressing the cellulosic ethanol sector by making the process cheaper and more competitive with ethanol produced from sugar and starch sources.

Therefore, the production of bio-ethanol in the country by small-scale industries through tomato wastes will be an essential, eco-friendly, and cost-effective alternative. This process involves converting the sugars in tomatoes into bio-ethanol, and solid waste into biochar which can be used as a fuel, and adsorbent respectively for various applications, including transportation, Energy Production and filteration. Our project aims to explore the feasibility, efficiency, and Ecological sustainability of Producing bio-ethanol from tomatoes, and to evaluate the potential of this innovative approach as sustainable biofuel research.

Through this project, we hope to contribute to the growing field of bioenergy research and Promote the utilization of tomato waste streams for renewable energy Products.

2. RAW MATERIALS:-

2.1. TOMATOES

- The scientific name of the tomato is Solanum-lycopersicum.

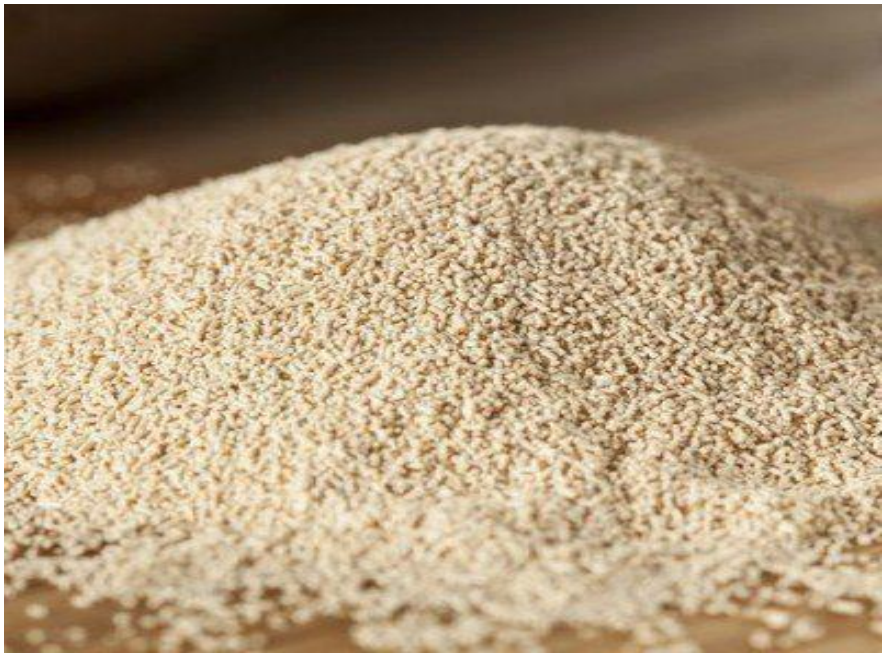
It is a warm-season crop that grows in tropical areas.

- While tomatoes are fruits, botanically classified as berries.
- They contain 2.49 gm of sugars per 100 gms of tomatoes.
- In young tomatoes the concentration of starch was as high as

20% of its dry weight and negligible in mature.

2.2. YEAST

- Yeasts are eukaryotic microorganisms scientifically known as **Saccharomyces cerevisiae**.



- It also play a key role in wastewater treatment or biofuel production.
- Yeast are very active at broad temperatures of 0-50°C.

2.3. DISTILLED WATER

- **Distilled water** is water that has been boiled into vapor and condensed back into liquid in a separate container.
- Impurities in the original water that do not boil below or near the boiling point of water remain in the original container.
- Thus, distilled water is a type of purified water.

2.4. Sugar

- Sugar is a soluble Carbohydrate which is also known as Monosaccharide
- It has a sweet taste and is derived from a plant known as sugarcane.

When these sugar break down into glucose and fructose, they help in the formation of alcohol.

3. METHODOLOGY

3.1. SAMPLE COLLECTION AND PREPARATION:

An appropriate quantity of overripe tomatoes (rotten tomato) were randomly collected from the local fruit market located in the Andhra Pradesh area of Guntur district in India. All the rotten tomatoes was packed in sterilized poly bags and stored at room temperature in the laboratory for 24 h.

3.1. FERMENTATION

Ethanol fermentation, also called alcoholic fermentation, is a biological process that converts sugars such as glucose, fructose, and sucrose into cellular energy producing ethanol and carbon dioxide as by-products. Because yeast performs this conversion in the absence of oxygen, alcoholic fermentation is considered an anaerobic process.

PROCEDURE

- Rotten tomatoes were washed with distilled water & finely blended and converted to pulp.
- 20 grams of yeast & 50 grams of sugar were weighed and added to the pulp.
- Then the whole mixture of pulp was makeup into 1liter solution by adding distilled water.
- The solution was filled in 1 liter bottles and closed with ballons containing holes to allow the Carbon dioxide to escape.
- 4 similar samples were prepared like this and left for Fermentation.

The chemical equations below summarize the fermentation of sucrose ($C_{12}H_{22}O_{11}$) into ethanol (C_2H_5OH). Alcoholic fermentation converts one mole of glucose into two moles of

ethanol and two moles of carbon dioxide, producing two moles of ATP in the process.

$$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$$

Sucrose is a sugar composed of a glucose linked to a fructose. In the first step of alcoholic fermentation, the enzyme invertase cleaves the glycosidic linkage between the glucose and fructose molecules.

$$C_{12}H_{22}O_{11} + H_2O + \text{invertase} \rightarrow 2\ C_6H_{12}O_6$$

Next, each glucose molecule is broken down into two pyruvate molecules in a process known as glycolysis.[2] Glycolysis is summarized by the equation:

$$C_6H_{12}O_6 \rightarrow 2\ CH_3COCOO + 2\ H_2O + 2\ H^+$$

CH_3COCOO^- is pyruvate. Finally, pyruvate is converted to ethanol and CO_2 in two steps, regenerating oxidized for glycolysis:

1. $CH_3COCOO^- + H^+ \rightarrow CH_3CHO + CO_2$

catalyzed by pyruvate decarboxylase

2. $CH_3CHO + H^+ \rightarrow C_2H_5OH$

This reaction is catalyzed by alcohol dehydrogenase.

3.2. SIMPLE DISTILLATION

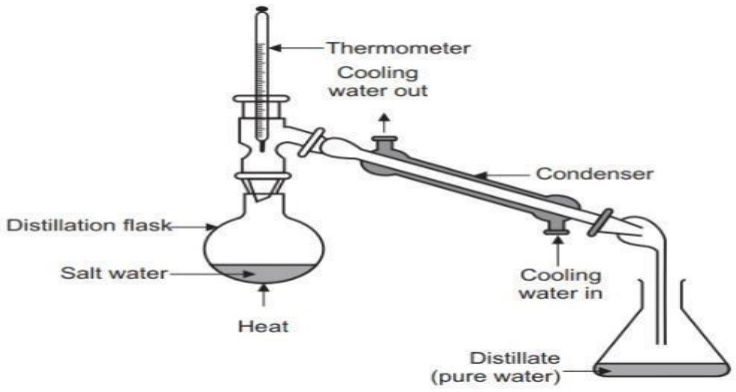
Simple distillation is method of separation of components from a liquid mixture which depends on the differences in boiling points of the individual components and the distributions of the components between a liquid and gas phase in the mixture. The liquid mixture may have different boiling point characteristics depending on the concentrations of the components present in it. Therefore, distillation processes depends on the vapor pressure characteristics of liquid mixtures. The vapor pressure is created by supplying heat as separating agent. In the distillation, the new phases differ from the original by their heat content.

This is a very energy intensive technique, especially when the relative volatility of the components is low. It is mostly carried

out in multi tray columns. Packed column with efficient structured packing has also led to increased use in distillation.

PROCEDURE

- The fermented mixture was filtered through filter cloth to remove the solid particles and dead yeast.
- Then the filtered solution was filled in a still kept to simple distillation at 70°C.(boiling point of enthanol is 78.37^{0}C)



- The vapors were recovered using a condenser and collected in a flask.
- This process was done for 4 samples at 4 different time intervals (72hrs, 144hr, 216hrs, 288hrs).

3.3. DRYING & PYROLYSIS

Drying is a mass transfer process consisting of the removal of water or another solvent by evaporation from a solid, semi-

solid or liquid. This process is often used as a final production step before selling or packaging products.

Pyrolysis is one of the various types of chemical degradation processes that occur at higher temperatures (above the boiling point of water or other solvents). It differs from other processes like combustion and hydrolysis in that it usually does not involve the addition of other reagents such as oxygen (O_2, in combustion) or water (in hydrolysis). Pyrolysis produces solids (char), condensable liquids (tar), and uncondensing/permanent gasses.

PROCEDURE

- After fermentation, the waste which is retained on the filter cloth is washed thoroughly with distilled water to remove impurities like dead yeast. After washing the materials are dried in an oven at 100 °C for 10-15 hrs.
- The samples are preserved in desiccators to avoid further absorption of moisture. A dried biomass sample is taken and reduces the particle size. The reduction of biomass particle size results in a high yield of biochar.
- After that small biomass particles were placed in a porcelain crucible and covered with a lid and placed in a proportional–

integral–derivative (PID) control muffle furnace at 600 °C for 2-3 hours.

- The carbonized husk samples are cooled and preserved for use in the next step of the procedure.

4. IDENTIFICATION

An officially recognized method for the determination of alcohol concentrations in alcohol-water mixtures either by weight (%w/w) or volume (%v/v; ABV = alcohol by volume) is the measurement of density followed by conversion into alcohol concentration using official alcohol tables.

Testing using Hydrometer

- The collect samples before and after fermentation and distillation was poured into 100ml measuring jar.
- Using a Hydrometer of range 0.95-1.00, was dipped into the jar and readings were noted.

4.2. How to find alcohol by volume %

ABV= 131.5*(INITIAL DENSITY – FINAL DENSITY)

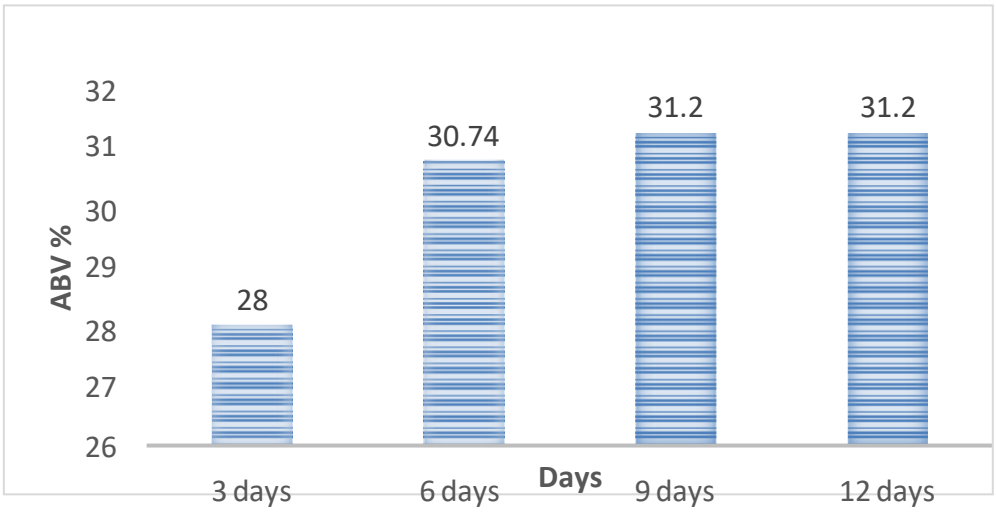
Initial density = density before fermentation

Final density = density after fermentation

ALCOHOL CONCENTRATIONS AT DIFFERENT TIME PERIODS

days	Initial gravity	Final gravity	Abv%
3	1.20	0.999	28%
6	1.20	0.97	30.74%
9	1.20	0.95	31.2%
12	1.20	0.95	31.2%

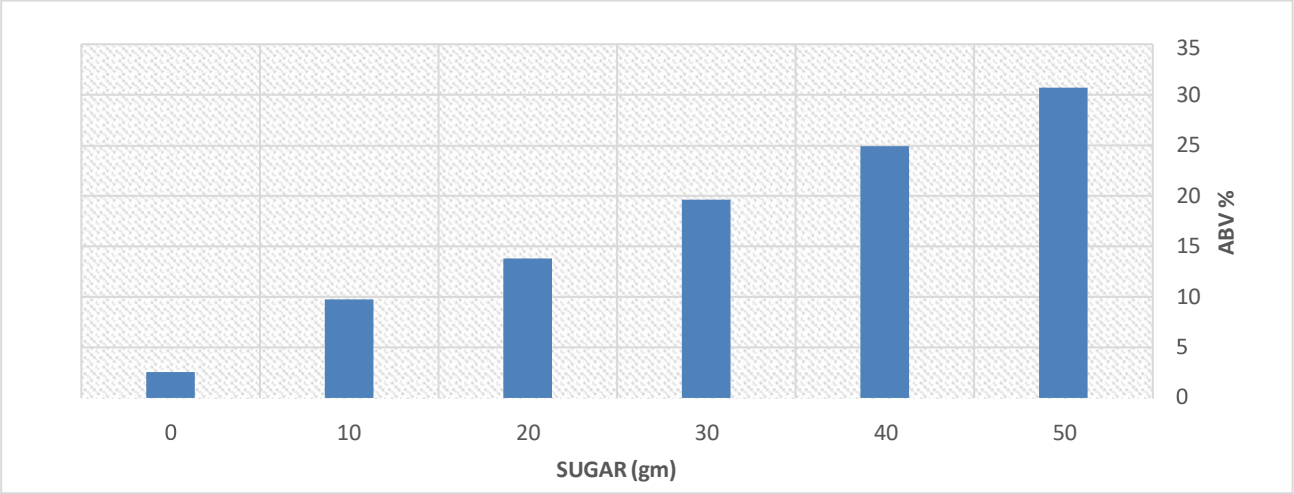
Here, when fermentation was done for 9 days & 12 days same amount of alcohol was produced and maximum upto 31% of alcohol was produced for 9 days.



4.3. ALCOHOL CONCENTRATION WITH VARYING SUGAR

The experiment was repeated with varying sugar content and compared.

SUGAR WT (gm)	ABV %
50	30.71
40	24.9
30	19.6
20	13.8
10	9.74
0	2.56

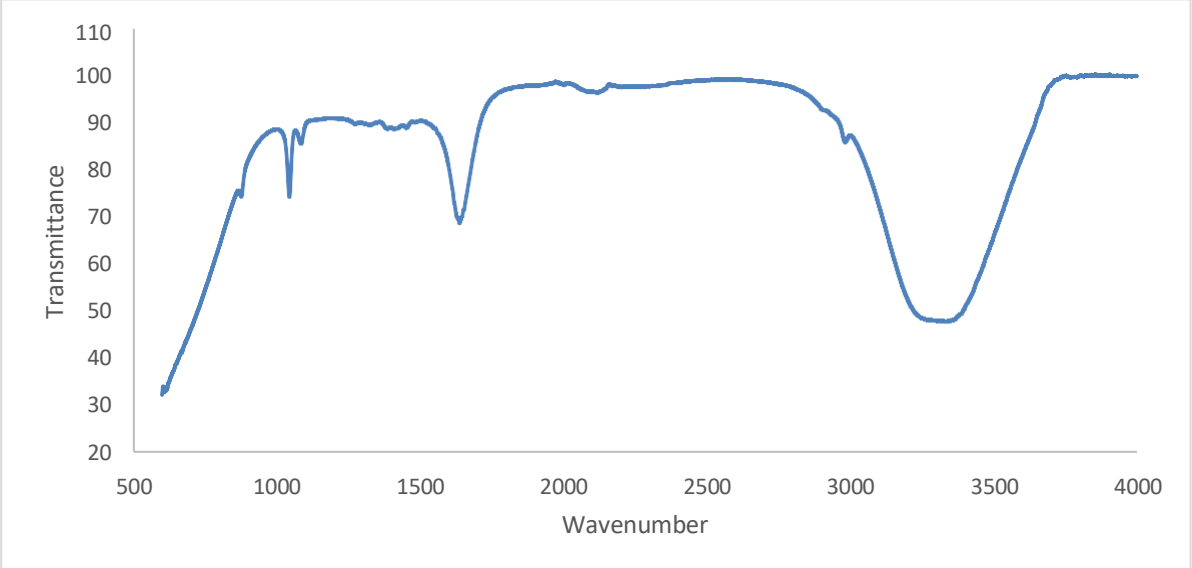


Here, when fermentation was done for 6 days & 20 gm yeast used for every sample. The results shows that increase in sugar, alcohol concentration also increased.

5. RESULTS & DISCUSSIONS

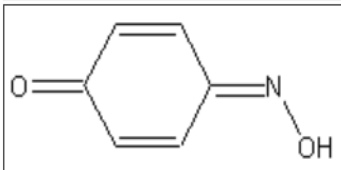
5.1. ANALYSIS FOR ALCOHOL

The best distilled sampled was filtered and sent for FTIR analysis to determine the presence of alcohol.

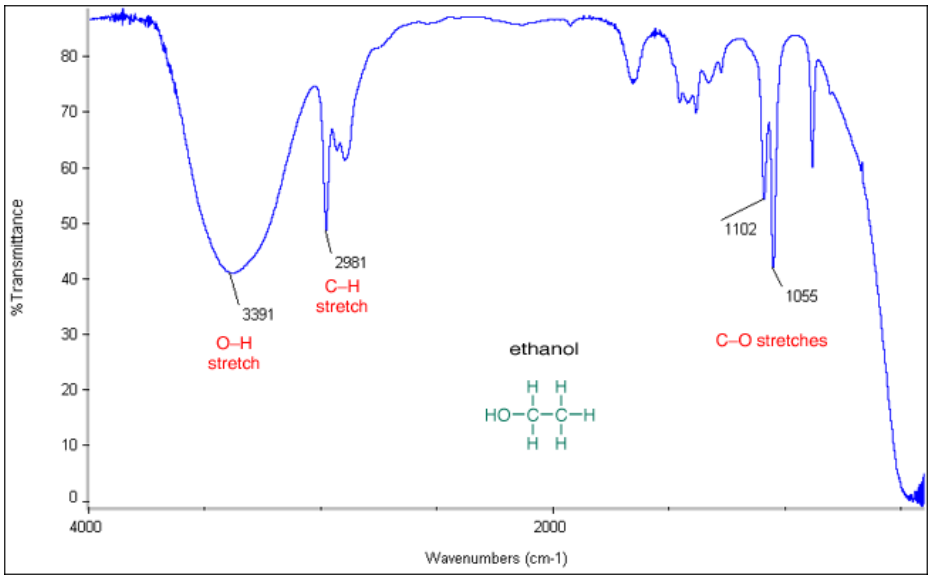


Fourier transform infrared spectroscopy (FTIR) of SAMPLE

Groups determination data:-

from	to	group	info
2700	3540	 Quinone oximes	s; broad O-H stretching vibration (associated)

1620	1680	$H_2C=CH_2$ isolated	w-m; C=C stretching vibration
1610	1640	$H_2C=CH_2$ conjugated with ar	m; C=C stretching vibration
1580	1660	C=C conjugated with C=C C=O	s; C=C stretching vibration

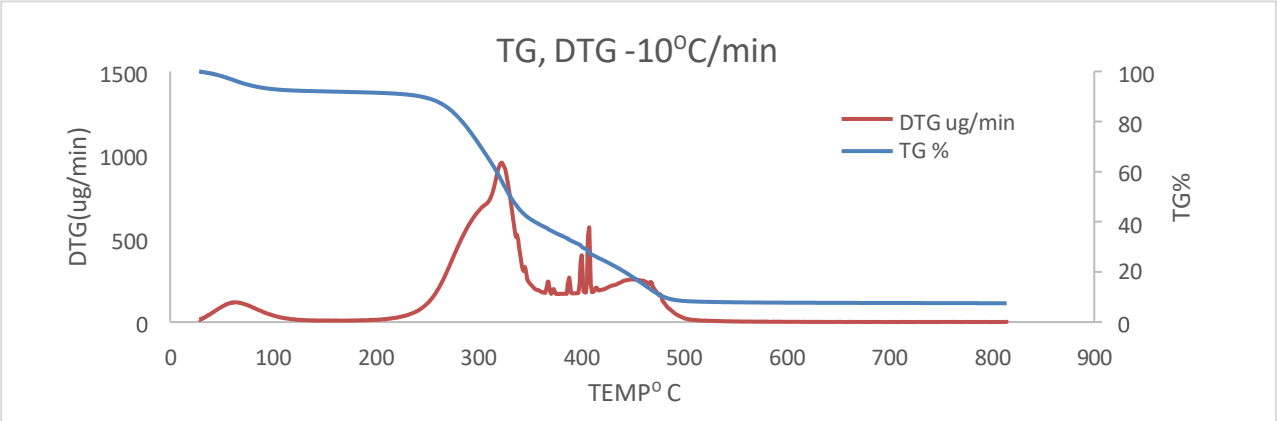


Fourier transform infrared spectroscopy (FTIR) of ALCOHOL

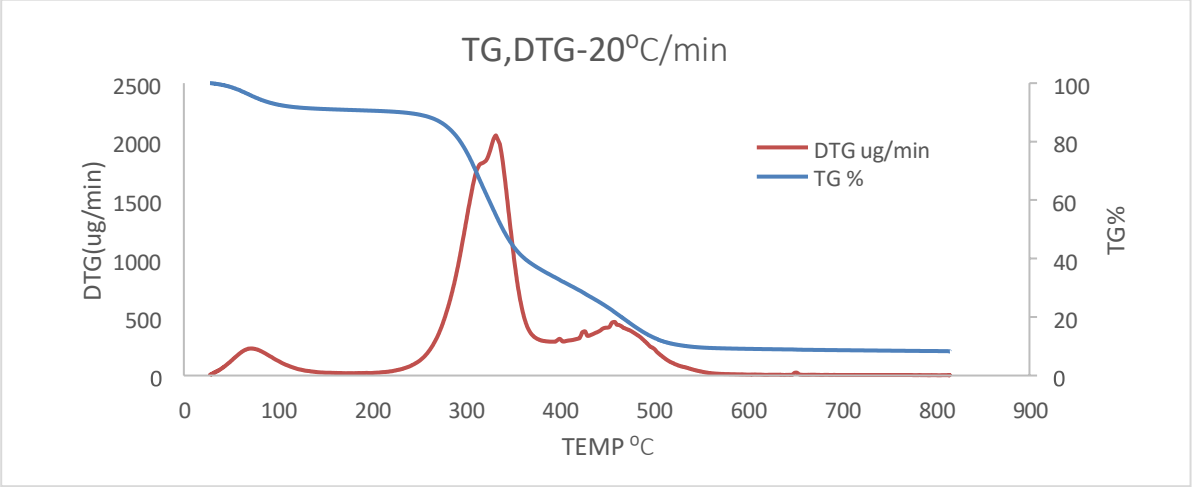
5.1. ANALYSIS FOR BIO-CHAR

- The bio-char from the solid waste was analysed and characteristics can be studied by "Thermo-gravimetric analysis and differential gravimetric analysis (TGA/DTG), Fourier transform infrared spectroscopy (FTIR), and Scanning electron microscopy (SEM) methods.

BY TGA/DTG METHOD

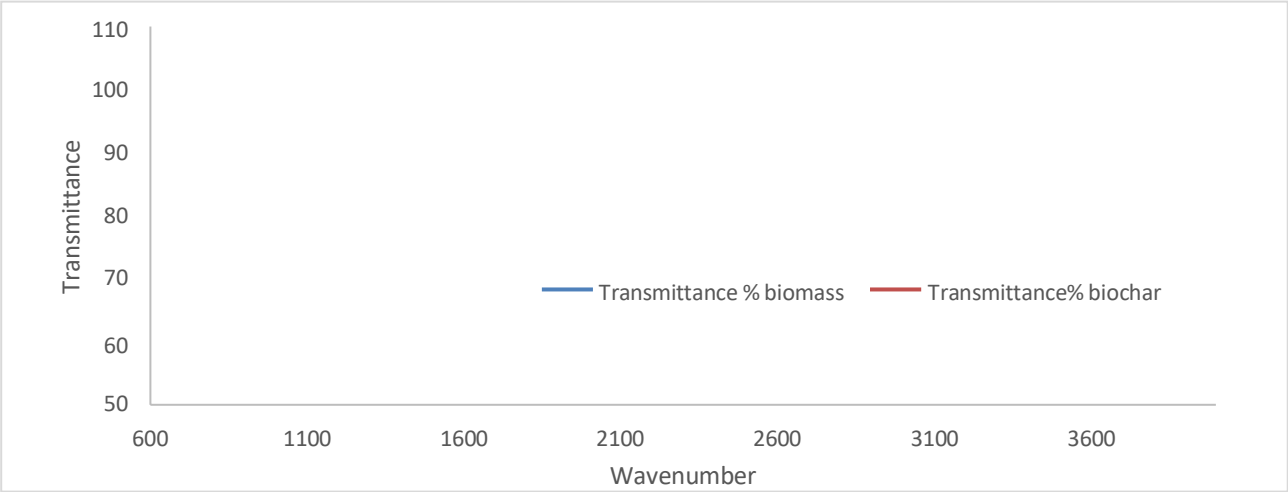


At a heating rate 10ºC/min, the first major stage was obtained between 250 ºC to 350ºC with 61.06 % of weight loss and the second stage between 390ºC to 500ºC with 23.03% of weight loss.



At a heating rate 20ºC/min, the first stage was obtained between 300 ºC to 380ºC with 66.01 % of weight loss and the second stage between 430ºC to 580ºC with 17.7% of weight loss.

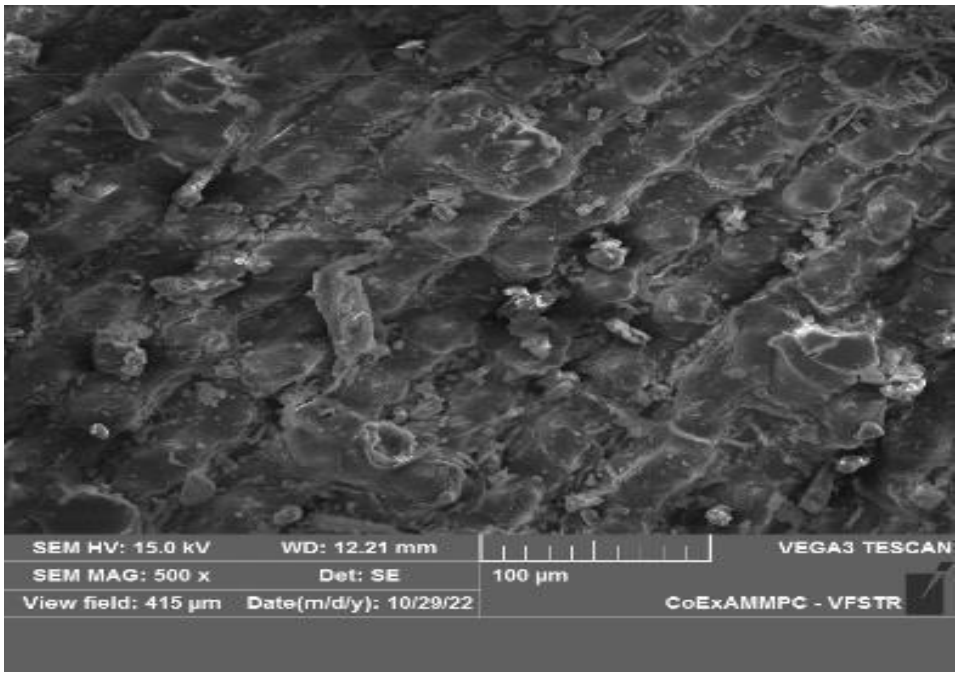
BY FTIR METHOD



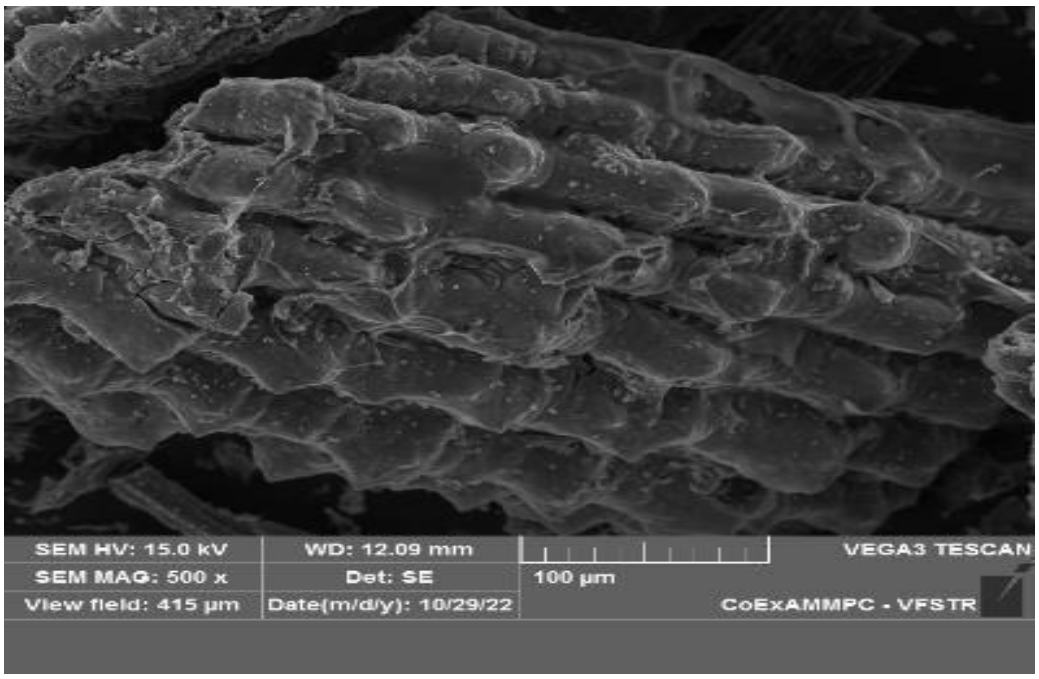
For the spectrum of biomass and biochar the greatest bands were observed at 1050 cm^{-1}, which was in the fingerprint region, and it was attributed to the C-O stretching.

However, in particular, when observing the spectrum of filtered waste biochar, some peaks could be clearly seen at 1087 cm^{-1}, and 800 cm^{-1},. which were attributed to the carbon-silicon group.

BY SEM METHOD



BIO-MASS



BIO-CHAR

The surface morphologies were analyzed using scanning electron microscope (SEM) and are presented in above figure for biomass, and biochar.

It was observed that good number of pores volumes are available in filtered waste biochar and also shows that pores are filled with heavy meatal after adsorption.

6. APPLICATIONS

BIO-ETHANOL

- Transport fuel to replace gasoline
- Fuel for power generation by thermal combustion
- Fuel for fuel cells by thermochemical reaction
- Fuel in cogeneration systems
- Feedstock in the chemicals industry

BIO-CHAR

- Used as soil conditioner
- Used to increase soil fertility
- As well as water holding capacity
- Used as adsorbent for waste water treatment

7. CONCLUSION

From the results produced, it can be concluded that the production of ethanol from tomatoes through enzymatic fermentation have been successful. However, the quantity of the production is still small with only the highest concentration is 35.20%. The time of the enzyme fermentation have been determined to effect on the production of ethanol with 9 days have been the optimum time for producing higher ethanol yield for tomatoes. Further research need to be done to determine the optimum condition in producing ethanol and thus producing higher concentration of ethanol for tomatoes as feedstock materials.

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A

FIELD PROJECT

REPORT

ON

Applying mathematical models to drying characteristics of ivy gourd

Submitted in the partial fulfillment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

In

Department of Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

(ACCREDITED BY NAAC WITH 'A+'GRADE)

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I would like to thank my guide **MS. ANANYA PAYAL**, Vignan's foundation for science technology and research, Vadlamudi. The interaction with her was really, fruitful and helped me in compiling this Field project report. My deepest thanks to **Dr. M. RAMESH NAIDU** Head of Chemical Department VFSTR, Vadlamudi for guiding me and extending all possible help to me and always inspiring me to do my work on this field project report with sincerity. Also, I wouldlike to thank **DR. B. SUMALATHA** whose trust and enthusiasm was constant motivation during ongoing work. Last but not leastI would like to thankful to all staff members of Department of Chemical Engineering, Vignan University, Vadlamudi and who directly or indirectly helped me in thecompletion of this project report.

UNDERTAKING

This is to declare that the field project entitled "**Applying mathematical models to drying characteristics of ivy gourd**" is an original work done by undersigned, in partial fulfillment of the requirements for the degree "Bachelor of Technology" from Department of Chemical Engineering.

All the analysis, design and system development have been accomplished by the undersigned. Moreover, this project has not been submitted to any other college or university.

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This is to certify that the field project entitled as, "**Study on drying characteristics of ivy gourd by using microwave technology**" submitted by 211LA02002, 211LA02003, 201FA02005, 201FA02009 to the Vignan's Foundation for Science, Technology and Research (Deemed to be) University, Guntur, Andhra Pradesh for the award of the degree of Bachelor of Technology is a bonafide record of the research work done by him/her under my supervision. The contents of this thesis, in full or in part, have not been submitted to any other institute or university for the award of any Degree.

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ABSTRACT

Ivy gourd is an important tropical vegetable cultivated in India. The quality characteristics of the ivy gourd slices are optimized. It also shortens the drying time of ivy gourd. The ivy gourds were treated in the microwave at different power levels 20%,40%, 60%. At 60% power level, that's 540 watts for a final moisture content of 6-7%. When the power level was 60%, it took 50 to 55 minutes; at the power level of 40%, it took 85 to 90 minutes; and at the power level of 20%, it took 3 hours. Here, the power level increased and the drying time was reduced. Dehydrated ivy gourd slices are obtained from the optimized treatment and have good color and texture. Vegetables preservation through drying technology is an effective method to minimize wastage while satisfying the essential nutrition requirements. The present study is intended to find suitable conditions to increase preservation capacity through different type of drying methods. Experiments are carried out in different temperatures to find the best temperature and we used microwave drying with different power levels. We carried out these experiments with three different powers (20,40,60) and in hot air oven with the temperature of 60 °c. The total drying period for microwave drying for 20 power is 170 min for 40 power is 70 min and for 60 power is 64 min.

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1. INTRODUCTION

Ivy gourd (Coccinia grandis) is a tropical plant from the pumpkin family and it is grown in several regions of south India. Ivy gourd is cost effective and it is widely available throughout the year. Its gives high yield from October–December (Rainy seasons). Ivy gourd is rich in β-carotene, which is a significant vitamin A and it is also considered as a good source of iron, vitamin C, protein and fibers. In order to extend the shelf life and preserve the freshness of vegetables, drying process can be adopted with the aid of new product. It is observed by the researchers that every part of the plant has unique values which can be used for its medical values. It has many medicinal applications such as skin diseases, bronchial catarrh, Hansen's disease, fever, infective hepatitis, icterus, and pharyngitis. the roots are used to treat osteoarthritis and joint pain. A paste made of leaves is applied to the skin to treat scabies. The medicinal properties of ivy gourd plant are focusing on its use as an antioxidant, anti- hypoglycemic agent, immune system modulator, etc. The ivy gourd stem, leaves, and flowers are consumed for their anti-diabetic, anti-ulcer, and skin disease-preventing properties. In most of the medicine preparation, ivy gourd is used in powdered form, in which the moisture content should be eliminated by the drying process. But there is no data available by using microwave. Based on the cited research literature it is found that, very few papers reported the energy and drying rate & moisture ratio of different varieties of pumpkin, but there is no research found on literature for ivy gourd. Hence, in this article, experimental works are carried out to find the energy and drying rate and moisture ratio by using microwave.

2. LITERATURE REVIEW

2.1. About drying

Drying is the process of removing excess water keeping the nutritive value, speed visibility, and further use.

Drying is a process that uses heat to remove water from a material. This can be done in a number of ways, including using an oven, a microwave, or a dehydrator. When water is removed from a material, its structure changes. This can make the material harder and less likely to spoil.

2.2. Drying techniques

- ✓ using food dehydrators,
- ✓ using the oven,
- ✓ sun drying,
- ✓ solar drying,
- ✓ air drying
- ✓ and microwave drying

3. METHODS AND PROCEDURE

3.1. Methods

- ✓ Hot air oven
- ✓ Microwave

Hot air oven

- The ivy gourds are wash and cut into small slices with uniform size and to calculate the physical parameters of ivy gourd like length, diameter, thicknessetc.
- Take 100gm of sample and place it a hot air oven at 115°c.
- After 2 hours the moisture content the sample is 94.25%.
- Take another sample and place it in a hot air oven at 60°c.
- After 8 hours the moisture content of the sample is 94%.
- By the reference of hot air oven and solar drying method
- We are conducting the experiment in the micro wave, up to now no one conduct the experiment on the micro wave.
- Compare to the pervious methods it is a fast and time saving method.
- In this process the self-life of the ivy gourd increases.

100 gm of ivy gourd slices

Hot air oven

Ivy gourd slices dried at 60^{o}c

After drying

Microwave

- The ivy gourds are wash and cut into small slices which is in uniform size andcalculate a physical parameters of the ivy gourd like length, diameter, thickness,etc…..
- Weigh the 100gms of ivy gourd slices and place it on the tray and that tray is kept in the micro wave.
- Now set the power level and drying time in the micro wave.
- Then weigh the sample for every 10minutes.
- Note down readings up to steady state occurs.

100 gm of ivy gourd slices

Micro wave

Ivy gourd slices were dried at different power levels (20%, 40%, and 60%).

After drying

4. Effects of different methods on drying kinetics of ivy gourd

4.1 Physical properties

Physical properties were evaluated to understand the effect of microwave power level on the quality of the ivy gourd and to compare it to the other drying equipment's.

- True density
- Bulk density
- porosity

✓ True density

It defined as the quotient of mass over the volume of a sample, without considering pores in the material (true volume).

True density= mass/true volume.

True density	
Hot air oven	0.695
Micro wave 20%	0.862
Micro wave 40%	0.735
Micro wave 60%	0.817

✓ Bulk density

Bulk density is defined as the mass of the many particles of the material divided by the total volume they occupy. The total volume includes particle volume, inter-particle void volume, and internal pore volume.

Bulk density= mass/ bulk volume.

Bulk density	
Hot air oven	0.1112
Micro wave 20%	0.194
Micro wave 40%	0.1130
Micro wave 60%	0.12014

✓ Porosity

Porosity is the open spaces between grains or trapped in grains in a microstructure - the presence of tiny openings or spaces within a material. It may also be represented in percent terms by multiplying the fraction by 100.

$$\textbf{Porosity}=1-\frac{bulk\ density}{true\ density}$$

Porosity	
Hot air oven	0.84
Micro wave 20%	0.774
Micro wave 40%	0.8462
Micro wave 60%	0.852

4.2 Rehydration ratio

Rehydration is process which is aimed at restoring the properties of a raw materials when the dried material comes in contact with water. rehydration is often carried out by soaking the dried material in water.

$$\text{Rehydration ratio}=\frac{weight\ of\ the\ drained\ sample}{Weight\ of\ dried\ sample}$$

Rehydration ratio	
Hot air oven	2.8796
Micro wave 20%	2.9009
Micro wave 40%	3.07145
Micro wave 60%	3.242

4.3 Shrinkage

- Shrinkage of food materials during drying is a common physical phenomenon which affects the textural quality and taste of the dried products.
- The shrinkage of food materials depends on many factors including material characteristics, microstructure, mechanical properties and process condition

Hot air oven	Micro wave 20%	Micro wave 40%	Micro wave 60%
0.9 cm	1.5 cm	1.1 cm	1.1 cm
1.0 cm	1.2 cm	1.2 cm	1.2 cm
0.9 cm	1.1cm	1.0 cm	0.9 cm
1.2 cm	1.7 cm	1.2 cm	1.3 cm
1.1 cm	1.2 cm	1.3 cm	1.3 cm
Average=1.02 cm	Average=1.34 cm	Average=1.16cm	Average=1.16 cm

4.4 Water activity

Water activity (aw) is the partial vapor pressure of water in a solution divided by the standard state partial vapor pressure of water.

Water activity	
Hot air oven	0.747
Micro wave 20%	0.724
Micro wave 40%	0.637
Micro wave 60%	0.587

4.5 Mathematical modelling

Mathematical Model	Equation
Henderson and Pabis	MR=ae^{-kt}
Modified Henderson and Pabis	MR=ae^{-kt}+be^{-gt}+c$e^{-\mathrm{h}t}$
Modified page	MR=$e^{-kt^{n}}$
Page	MR=e^{-kt}
Verma et al	MR=ae^{-kt}+(1-a)e^{-gt}
Logarithmic	MR=ae^{-kt}+c
Diffusion approach	MR=ae^{-kt}+(1-a) e^{-kat}
Newton	MR=e^{-kt}
Two-term	MR=a$e^{-k_0 t}$+b$e^{-k_1 t}$

5. Analysis

5.1 DPPH(2,2-DIPHENYL-I-PICRYLHYDRAZYL)

- ✓ DPPH solution Preparation
  - Add 4mg of DPPH into a 100ml of volumetric flask and makeup with methanol.
  - It's compulsory that all the radical must be dissolve completely & flask is wrapped with foil.
- ✓ Sample Preparation
  - Take 0.2-0.5 g of sample in conical flask & add 20 ml of methanol into it
  - Keep the sample mixture for orbital shaker for 2.5 -3 hrs at room temperature.
  - Then centrifuge the sample to separate the supernatant at 6000 RPM for 20 minutes.
- ✓ Analysis
  - Fill two test tubes half way (2.62 ml) with methanol, then add 0.08 ml of methanol (control) and 0.08 ml of sample extract.
  - Add 2.5 ml of DPPH solution.
  - For 30 minutes, incubate the reaction mixture in dark at room temperature.
  - After 30 minutes, the absorbance of the mixture was measured at 517nm.

Percentage antioxidant activity=$(\frac{A_c - A_S}{A_c}) * 100.$

Were,

$$A_c = Absorbance\ of\ the\ control$$

$$A_s = Absorbance\ of\ the\ sample$$

5.2 TFC (TOTAL FLAVONOID CONTENT)

The total flavonoid content (TFC) in plants is usually determined calorimetrically after solvent extraction. One of the widely followed methods for the determination of TFC in plant extracts is the aluminum chloride colorimetric assay, where Al (III) is utilized as a complexing agent.

- ✓ Procedure (for the TFC test)
  - Take a flask, now pore the 5ml extract sample with 0.3ml of NaNo2.
  - Keep it a side for 5min, after that add 0.3ml of 10% Alcl3 Into the test tube.
  - Now add 1N of NaoH solution into the test-tube.

- Add 4ml of distilled water**.**

5.3 TPC (TOTAL PHENOLIC CONTENT)

Total Phenolic Content TPC activity is the process to figure out the amountof phenolic content in the samples. Phenolic compounds that contained in the plants have redox properties, and the properties allow them acting as antioxidants.

✓ Procedure (for the TPC test)

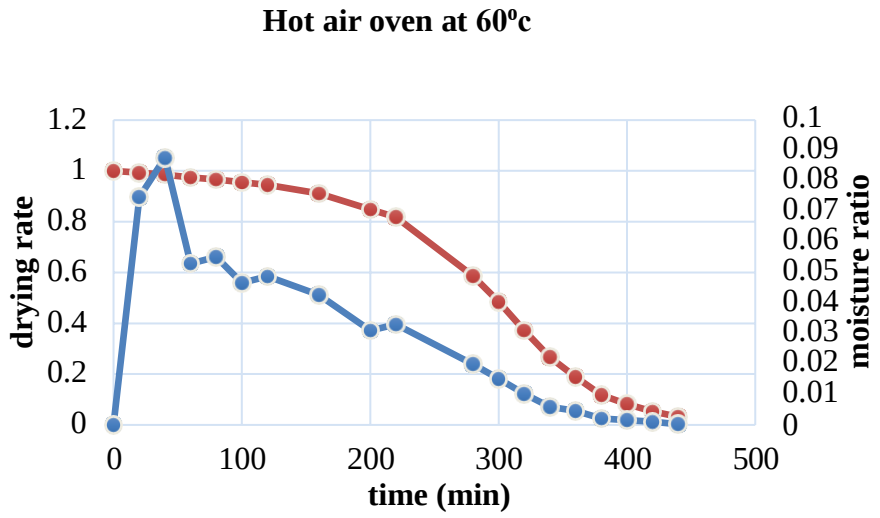
- Take 25ml flask, now pore the 5ml extract sample with 1ml reagent.
- Keep it a side for 6min, after that add 10ml na2co3 (7%) and 9ml distilled water.
- now incubated for 30 minutes.
- By using spectrometer, the sample was tested. Effects of different methods

6. Results and Discussion

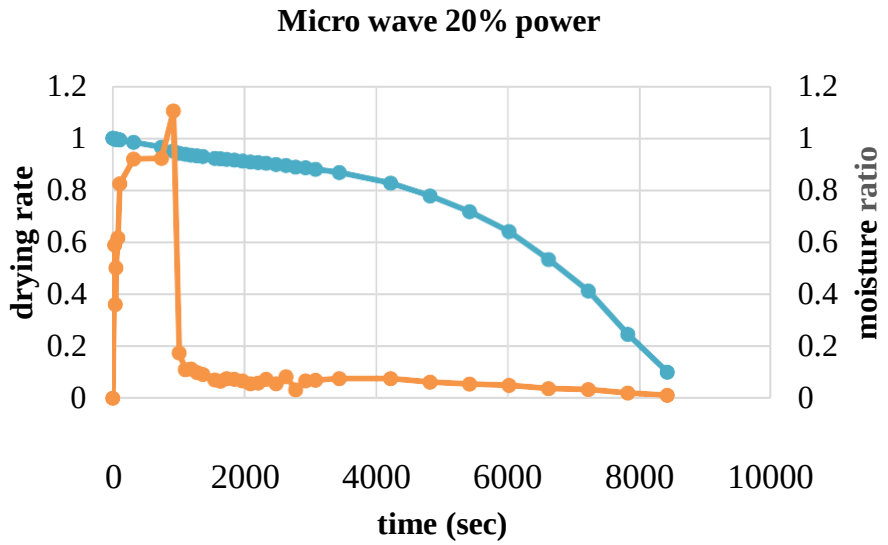
- The experiment was conducted to drying rate of samples that were treated in different methods.
- This experiment was carried out at different power levels (20%, 40%, 60%) by taken the hot air oven data is a controller.

6.1 Comparison between drying rate v/s time v/s moisture ratio

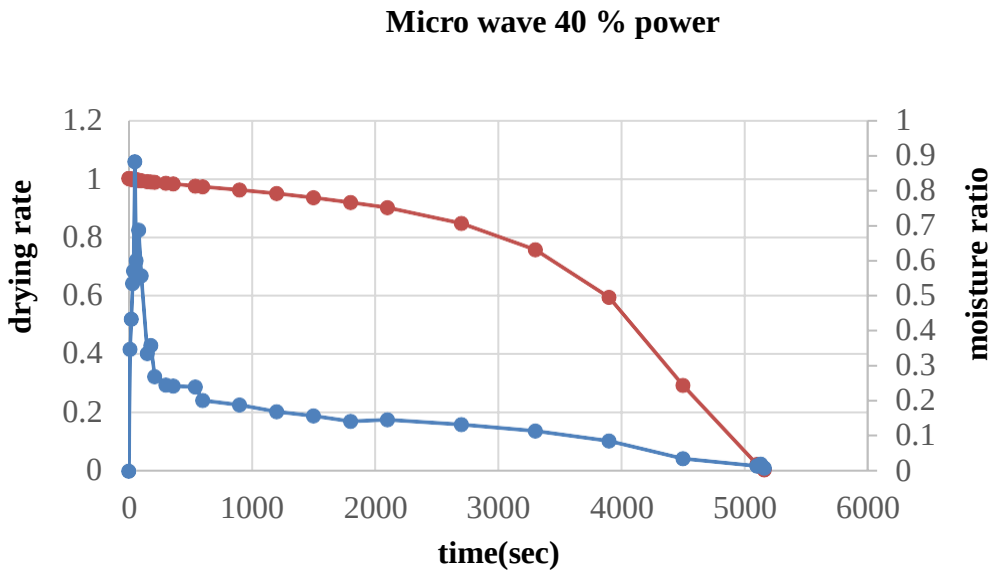
✓ **Hot air oven at 60°c (Drying rate v/s time v/s moisture content)**



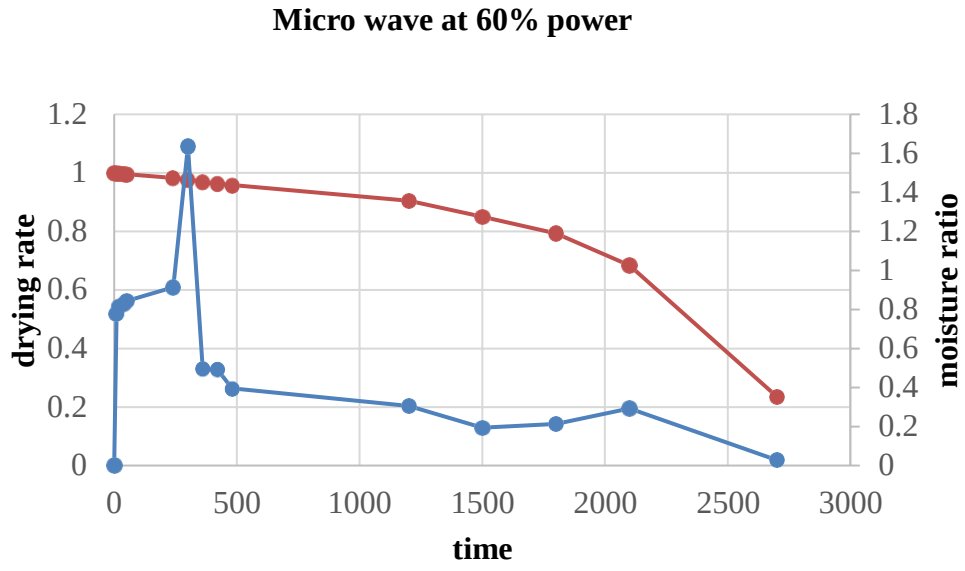
✓ **Micro wave 20% power (Drying rate v/s time v/s moisture content**



✓ **Micro wave 40 % power (Drying rate v/s time v/s moisture content)**



✓ **Micro wave at 60% power (Drying rate v/s time v/s moisture content)**



6.1 Mathematical modelling

Models	microwave power levels	R^2	chi-square
page	20%	0.96924	0.00234
	40%	0.9755	0.00213
	60%	0.96678	0.0026
Modified page	20%	0.96924	0.00234
	40%	0.9755	0.0213
	60%	0.966788	0.0026
Modified Pabis and Henderson	20%	0.69768	0.02468
	40%	0.75964	0.02368
	60%	0.75019	0.02472
Henderson and Pabis	20%	0.69768	0.02298
	40%	0.75964	0.02089
	60%	0.75019	0.01953
verma et al	20%	0.83397	0.01284
	40%	0.87989	0.01076
	60%	0.87208	0.01055
Logarithmic	20%	0.69767	0.02338
	40%	0.75963	0.02153
	60%	0.75737	0.02012
Diffusion approach	20%	0.82198	0.01353
	40%	0.86903	0.01138
	60%	0.86232	0.01076
newton	20%	0.61991	0.0284
	40%	0.69187	0.02602
	60%	0.68698	0.02325
two-term	20%	0.69768	0.0238
	40%	0.75964	0.0222
	60%	0.75019	0.02183

6.2 DPPH Results

✓ Anti-oxidant activity

	0.2	0.4	0.6	0.8
Microwave 20% power	40.04%	76.94%	83.07%	84.83%
Microwave 40% power	39.2105%	49.586%	68.106%	76.915
Microwave 60% power	29.583%	35.1748%	76.193%	77.3756%
Hot air oven 60°c	44.32%	45.70%	71.75%	74.052%

6.3 TFC Values

EXTRACT	ABS	K*ABS
Blank sample	0.0004	0.00041
Microwave 20% Power level	0.2555	0.25553
	0.2563	0.25632
Microwave 40% Power level	0.4362	0.43623
	0.4364	0.43643
Microwave 60% Power level	0.9019	0.90189
	0.8915	0.89151
Hot air oven 60°c	0.9101	0.91011
	0.9141	0.91410

6.4 TPC Values

- Hot air oven 60°c– 16.68 mg GAE/g
- Microwave 60% power level – 9.09mg GAE/g
- Microwave 40% power level – 5.57mg GAE/g
- Microwave 20% power level – 3.28mg GAE/g

6.5 Discussion

- By taking previous reference papers, conducted the experiment in a hot air ovenat 60◦c. This is taken as a controller.
- After conducting the same experiment in the microwave at different power levels.
- The time was reduced in the micro wave than compare to hot air oven. Microwave dryers heat the substance to the very core and hence remove the unbound as well as the bound moisture from the lattice.

7. APPLICATIONS

- Market for dehydrated products is increasing due to extended shelf life
- The ivy gourd is used for many applications such as skin diseases, Hansen's disease, fever, infective hepatitis.
- The ivy gourd leaves, stem and flowers are used as an anti-diabetic, skin diseases-preventing properties.

8. CONCLUSION

Conclusion:

- The experimental analysis of ivy gourd was carried out to develop the semi- empirical thin layer drying kinetics moisture ratio correlation based on hot air oven(controller) and microwave.
- Drying times were decreased in microwave compared to hot air oven.
- Increase in power level of the microwave decreased the drying time.

Treatment methods	Time
Hot air oven	6-7 hours
Microwave 20%	3 hours
Microwave 40%	85-90 minutes
Microwave 60%	50 minutes

- The best fitted models are page and modified page models.

9. REFERENCES

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A

FIELD PROJECT

ON

Study on drying characteristics of ivy gourd by using microwave technology

Submitted in the partial fulfillment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

In

Department of Chemical Engineering

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ACKNOWLEDGEMENT

I would like to thank my guide **Dr. M. RAMESH NAIDU**, Vignan's foundation for science technology and research, Vadlamudi. The interaction with her was really, fruitful and helped me in compiling this project report. My deepest thanks to **Dr. M. RAMESH NAIDU** Head of Chemical Department VFSTR, Vadlamudi for guiding me and extending all possible help to me and always inspiring me to do my work on this project report with sincerity. Also, I would like to thank **DR. VIJETHA** whose trust and enthusiasm was constant motivation during ongoing work. Last but not least I would like to thankful to all staff members of Department of Chemical Engineering, Vignan University, Vadlamudi and who directly or indirectly helped me in the completion of this project report.

UNDERTAKING

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All the analysis, design and system development have been accomplished by the undersigned. Moreover, this project has not been submitted to any other college or university.

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CERTIFICATE

This is to certify that the field project entitled as, ""**EXTRACTION OF CAPSAICIN OLEORESIN FROM RED CHILLIES**" submitted by 211FA02007, 211FA02011, 221LA02002, 221LA02005, 221LA02009 to the Vignan's Foundation for Science, Technology and Research (Deemed to be University), Guntur, Andhra Pradesh for the award of the degree of Bachelor of Technology is a bonafide record of the research work done by him/her under my supervision. The contents of this thesis, in full or in part, have not been submitted to any other institute or university for the award of any Degree.

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ABSTRACT

Ivy gourd is an important tropical vegetable cultivated in India. The quality characteristics of the ivy gourd slices are optimized. It also shortens the drying time of ivy gourd. The ivy gourds were treated in the microwave at different power levels 20%, 40%, 60%. At 60% power level, that's 540 watts for a final moisture content of 6-7%. When the power level was 60%, it took 50 to 55 minutes; at the power level of 40%, it took 85 to 90 minutes; and at the power level of 20%, it took 3 hours. Here, the power level increased and the drying time was reduced. Dehydrated ivy gourd slices are obtained from the optimized treatment and have good color and texture.

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5. Applications

6. Conclusion

7. Reference

1. INTRODUCTION

Ivy gourd (Coccinia grandis) is a tropical plant from the pumpkin family and it is grown in several regions of south India. Ivy gourd is cost effective and it is widely available throughout the year. Its gives high yield from October–December (Rainy seasons). Ivy gourd is rich in β-carotene, which is a significant vitamin A and it is also considered as a good source of iron, vitamin C, protein and fibers. In order to extend the shelf life and preserve the freshness of vegetables, drying process can be adopted with the aid of new product. It is observed by the researchers that every part of the plant has unique values which can be used for its medical values. It has many medicinal applications such as skin diseases, bronchial catarrh, Hansen's disease, fever, infective hepatitis, icterus, and pharyngitis. the roots are used to treat osteoarthritis and joint pain. A paste made of leaves is applied to the skin to treat scabies. The medicinal properties of ivy gourd plant are focusing on its use as an antioxidant, anti-hypoglycemic agent, immune system modulator, etc. The ivy gourd stem, leaves, and flowers are consumed for their anti-diabetic, anti-ulcer, and skin disease-preventing properties. In most of the medicine preparation, ivy gourd is used in powdered form, in which the moisture content should be eliminated by the drying process. But there is no data available by using microwave. Based on the cited research literature it is found that, very few papers reported the energy and drying rate & moisture ratio of different varieties of pumpkin, but there is no research found on literature for ivy gourd. Hence, in this article, experimental works are carried out to find the energy and drying rate and moisture ratio by using microwave.

2. LITERATURE REVIEW

2.1. About drying

Drying is the process of removing excess water keeping the nutritive value, speed visibility, and further use.

Drying is a process that uses heat to remove water from a material. This can be done in a number of ways, including using an oven, a microwave, or a dehydrator. When water is removed from a material, its structure changes. This can make the material harder and less likely to spoil.

2.2. Drying techniques

- using food dehydrators,
- using the oven,
- sun drying,
- solar drying,
- air drying
- and microwave drying

3. METHODS AND PROCEDURE

3.1. Methods

- Hot air oven
- Microwave

Hot air oven

- The ivy gourds are wash and cut into small slices with uniform size and to calculate the physical parameters of ivy gourd like length, diameter, thickness etc.
- Take 100gm of sample and place it a hot air oven at $115°c$.
- After 2 hrs the moisture content the sample is 94.25%.
- Take another sample and place it in a hot air oven at $60°c$.
- After 8 hrs the moisture content of the sample is 94%.
- By the reference of hot air oven and solar drying method
- We are conduct the experiment in the micro wave, up to now no one conduct the experiment on the micro wave.
- Compare to the pervious methods it is a fast and time saving method.
- In this process the self-life of the ivy gourd increases.

100 gm of ivy gourd slices

Hot air oven

Ivy gourd slices dried at 60ºc

After drying

Microwave

- The ivy gourds are wash and cut into small slices which is in uniform size and calculate a physical parameters of the ivy gourd like length, diameter, thickness, etc….
- Weigh the 100gms of ivy gourd slices and place it on the tray and that tray is kept in the micro wave.
- Now set the power level and drying time in the micro wave.
- Then weigh the sample for every 10minutes.
- Note down readings up to steady state occurs.

100 gm of ivy gourd slices

Micro wave

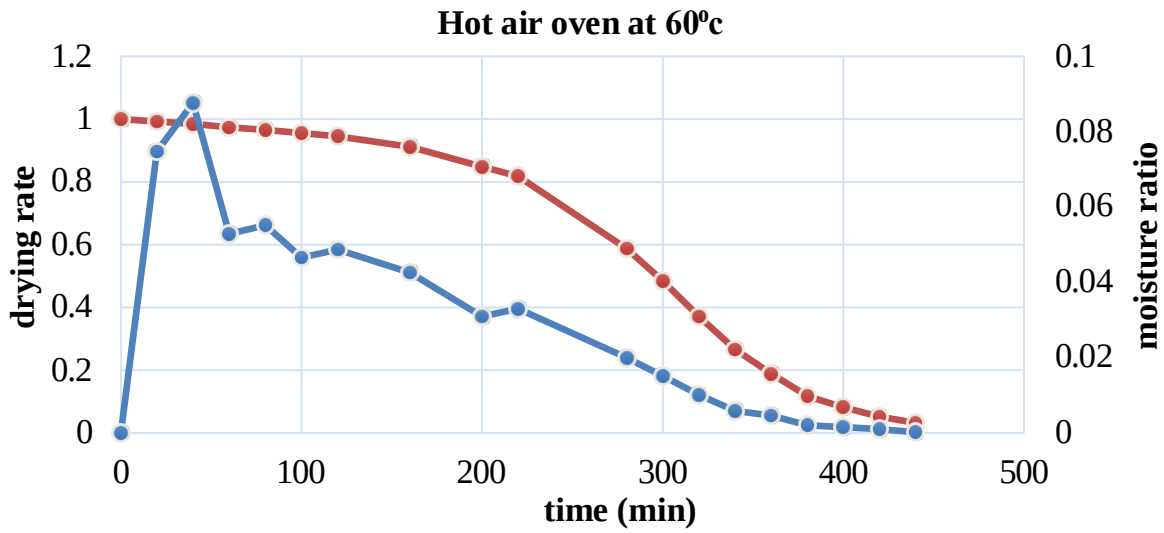
Ivy gourd slices were dried at different power levels (20%, 40%, and 60%).

After drying

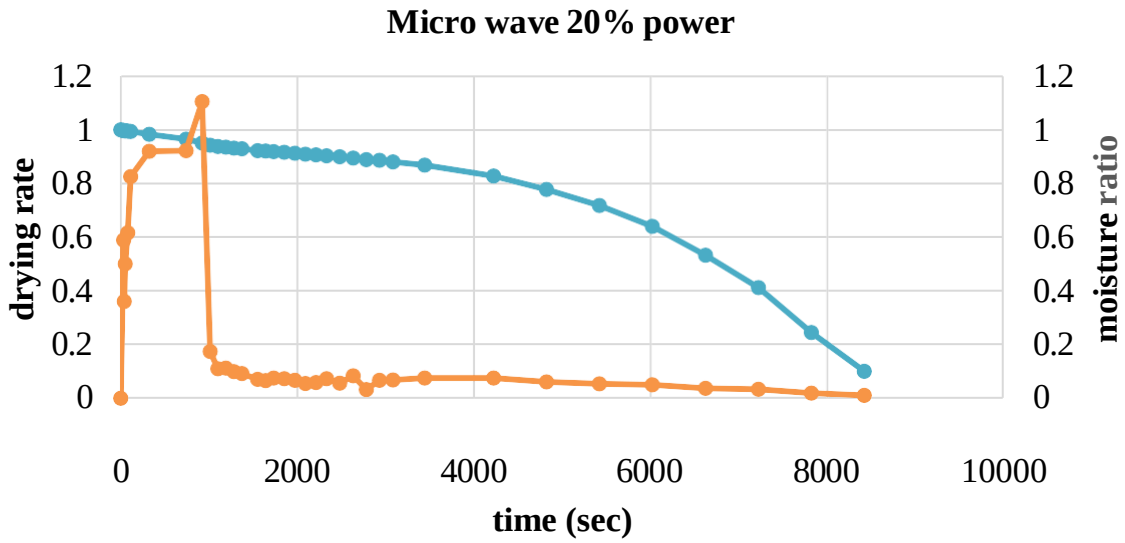
4. RESULT AND DISCUSSION

Results

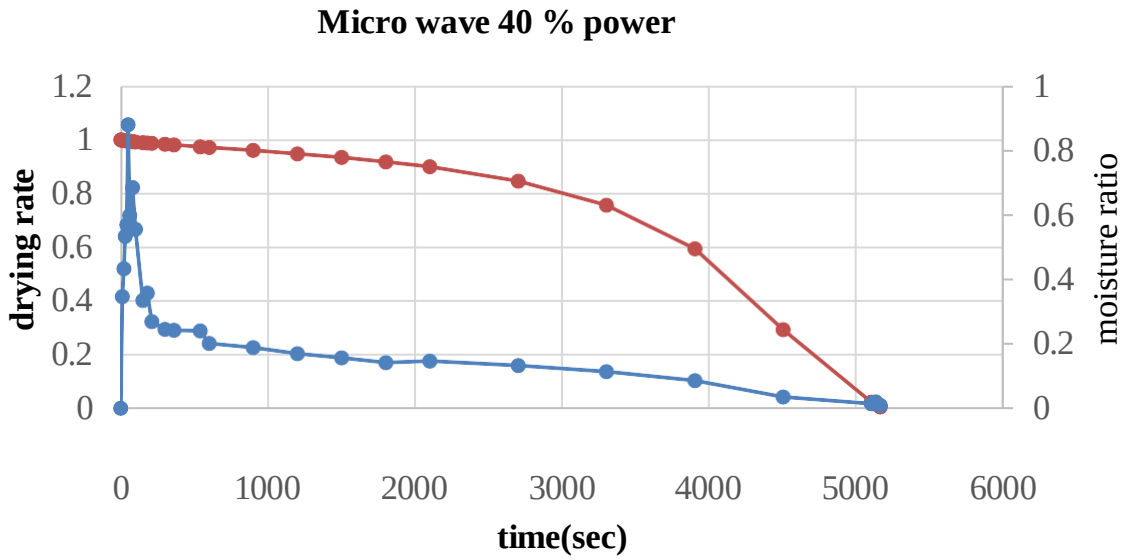
1. Hot air oven at 60ºc (Drying rate v/s time v/s moisture content)



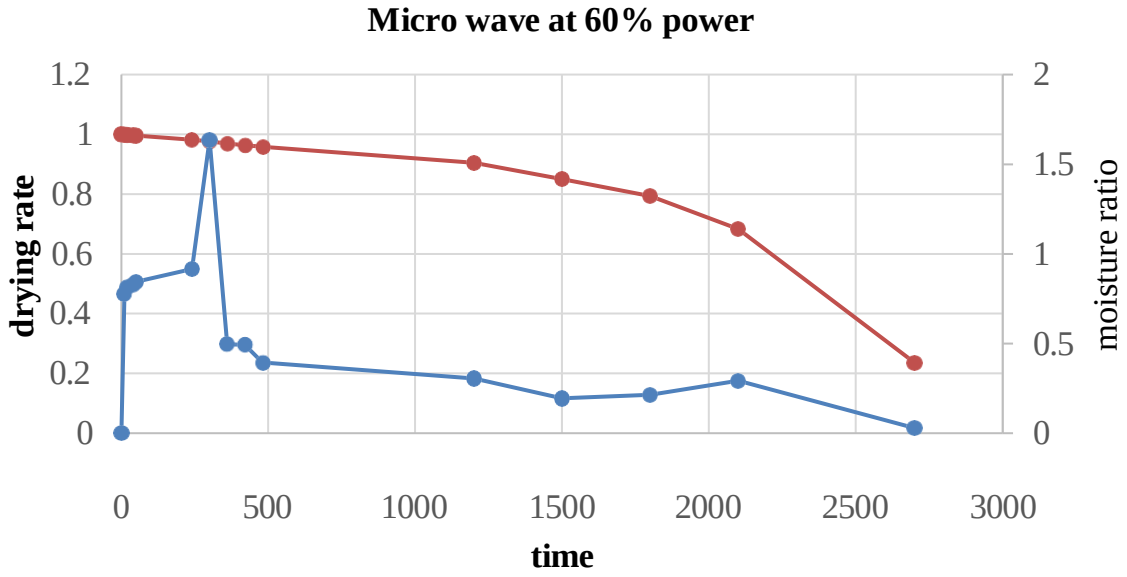
2. Micro wave 20% power (Drying rate v/s time v/s moisture content)



3. Micro wave 40 % power (Drying rate v/s time v/s moisture content)



4. Micro wave at 60% power (Drying rate v/s time v/s moisture content)



Discussion

- By taking previous reference papers, conducted the experiment in a hot air oven at 60◦c. This is taken as a controller.
- After conducting the same experiment in the microwave at different power levels.
- The time was reduced in the micro wave than compare to hot air oven. Microwave dryers heat the substance to the very core and hence remove the unbound as well as the bound moisture from the lattice

5. APPLICATIONS

- It has many ayurvedic and medicinal applications, such as treating skin diseases, Hansen's disease, fever, and infective hepatitis.
- Its stem, leaves, and flowers are consumed for their anti-diabetic, anti-ulcer, and disease-preventing properties.

6. CONCLUSION

Conclusion:

- The experimental analysis of ivy gourd was carried out to develop the semi-empirical thin layer drying kinetics moisture ratio correlation based on hot air oven(controller) and microwave.
- Drying times were decreased in microwave compared to hot air oven.
- Increase in power level of the microwave decreased the drying time.

Treatment methods	Time
Hot air oven	6-7 hours
Microwave 20%	3 hours
Microwave 40%	85-90 minutes
Microwave 60%	50 minutes

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A

FILED PROJECT

ON

"BIODIESEL PRODUCTION FROM JATROPHA OIL"

Submitted in the partial fulfillment of the requirements for the award of the degree
BACHELOR OF TECHNOLOGY

In
Department of Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

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UNDERTAKING

This is to declare that the project entitled "**BIODIESEL PRODUCTION FROM JATROPHA OIL** " is an original work done by undersigned, in partial fulfillment the requirements for the degree "Bachelor of Technology" from Department of Chemical Engineering ,division of petroleum engineering .

All the analysis, design and system development have been accomplished by the undersigned. Moreover, this project has not been submitted to any other college oruniversity.

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This is to certify that the field project entitled as, "**BIODIESEL PRODUCTION FROM JATROPHA OIL**" submitted by 211FA02002, 221LA02003, 221LA02004, 221LA02007, 221LA02008 to the Vignan's Foundation for Science, Technology and Research (Deemed to be University), Guntur, Andhra Pradesh for the award of the degree of Bachelor of Technology is a bonafide record of the research work done by him/her under my supervision. The contents of this thesis, in full or in part, have not been submitted to any other institute or university for the award of any Degree.

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ABSTRACT

Biodiesel, a promising substitute as an alternative fuel has gained significant attention due to the predicted shortness of conventional fuels and environmental concern. The utilization of liquid fuels such as biodiesel produced from Jatropha oil by transesterification process represents one of the most promising options for the use of conventional fossil fuels. The Jatropha oil is converted into jatropha oil methyl ester known as bio- diesel prepared in the presence of homogeneous acid catalyst. The physical properties such as density, flash point, Kinematic viscosity, Cloud point and Pour point were found out for Jatropha oil and Jatropha methyl ester. The same characteristics study was also carried out for the diesel fuel for obtaining the base line data for analysis. The value obtained from the Jatropha methyl ester is closely matched with the values of conventional diesel and can be used in the existing diesel engine without any modification.

Keywords: jatropha oil, transesterification, biodiesel

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2) literature Review

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2.2 Reaction

2.3 parameter to be consider

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4.1 characterization

4.2 results

4.3 engine performance

5) Conclusion

6) References

1. INTRODUCTION

Biodiesel is an alternative fuel made from renewable biological sources such as vegetable oils both (edible and non edible oil) and animal fats. Vegetable oils are usually ester glycol with diffe -rential chain length and degree of saturation. It may be seen that vegetable contains substantial amount of oxygen in their molecules. Practically the high viscosity of vegetable oils (30- 200 Centistokes) as compared to that to Diesel (5.8- 6.4 Centistokes) leads to oils unfavorable pump, inefficient mixing of fuel with air contributes incomplete combustion, high flash point result in increased carbon deposit formation and inferior coking. Due to these problems, vegetable oil needs to be modified to bring the combustion related properties closer to those of Diesel oil. The fuel modification is mainly aimed at reducing the viscosity and increasing the volatility. One of the most promising processes to convert vegetable oil into methyl ester is the transesterification, in which alcohol reacts with triglycerides of fatty acids (vegetable oil) in the presence of catalyst. Jatropha vegetable oil is one of the prime non edible sources available in India. The vegetable oil used for biodiesel production might contain free fatty acids which will enhance saponification reaction as side reaction during the transesterification process.

All countries are at present heavily dependent on petroleum fuels for transportation and agricultural machinery. The fact that a few nations together produce the bulk of petroleum has led to high price fluctuation and uncertainties in supply for the consuming nations. This in turn has led them to look for alternative fuels that they themselves can produce. Among the alternatives being considered are methanol, ethanol, biogas and vegetable oils. Vegetable oils have certain features that make them attractive as substitute for Diesel fuels.
Vegetable oil has the characteristics compatible with the CI engine systems. Vegetable oils are also miscible with diesel fuel in any proportion and can be used as extenders. India highly depends on import of petroleum crude and nearly two third of its requirement is met through imports. Moreover the gases emitted by petrol, diesel driven vehicles have an adverse effect on the environment and human health.

1. LITERATURE REVIEW

Introduction to work

2.1 Mechanism

2.1.1 **Transesterification**:

Is the process of chemically reacting a fat or oil with an alcohol in a presence of a catalyst. Alcohol used is usually methanol or ethanol Catalyst is usually sodium hydroxide or potassium hydroxide. The main product of transesterification is biodiesel and the co-product is glycerin

2.2 Reaction :-

Neutralization: The vegetable oil contains about 14- 19.5 % free fatty acids in nature, it must be freed before taken into actual conversion process. The presence of about 14% of free fatty acid makes Jatropha oil inappropriate for industrial biodiesel production.

The dehydrated oil is agitated with 4 % HCl solution for 25 minutes and 0.82 gram of NaOH was added per 100 ml of oil to neutralize the free fatty acids and to coagulate by the following reaction. $RCOOH + NaOH \rightarrow RCOONa + H_2O$ The coagulated free fatty acid (soap) is removed by filtration. This process brings the free fatty acid content to below 2 % and is perfect source for biodiesel production

2.3 Parameter to be consider :-

SNO	PARAMEĽERS	OPTIMIZATION CONDITIONS
1	catalyst amount	2.5 GRAMS
2	tempeíatuíe	60-70 C
3	íeaction time	60-90 minutes
4	methanol/oil íatio,	1:1.5
5	biodiesel yield	100ML

Factor effecting

Scarcity, insecurity, and severe environmental impact of fossil fuel-based energy consumption have enthused the production and utilization of alternative energy resources. Biodiesel is identified as promising renewable energy that can substitute the petrol diesel consumption with numerous advantages. However, more than 95% of biodiesel is produced from edible oil crops, which jeopardizes the food supplies. As a result, exploring inexpensive and non-edible oil- bearing energy crops such as jatropha *curcas* (Jatropha) has been the target of governments, researchers, industries, and policymakers.

However, sustainable biodiesel production from this plant is not achieved yet due to various ecological, socioeconomic, legislative, and technological factors. Previous reports showed that the individual impact of those factors; however, all factors are strongly correlated, and the impactof one factor is significantly affected by the situation of other factors. Therefore, the present review is devoted to critically examine and discuss the sole and interactive effect of various factors affecting the cultivation of Jatropha for sustainable biodiesel production by reviewing more than 185 published articles.

Various oil extraction and biodiesel production technologies and factors affecting the physicochemical properties of Jatropha oil and biodiesel were profoundly investigated. Moreover, the performance, combustion, and emission characteristic of diesel engines fuelled with Jatropha biodiesel were carefully reviewed and compared with petrol diesel. In conclusion, factors affecting the sustainable biodiesel production potential of Jatropha vary across growing regions due to variation in determinants, and the performance and emission characteristic of diesel engines fueled with Jatropha biodiesel slightly differed from petrol diesel.

Source of jatropha Oil: The plant that is generally cultivated for the purpose of extracting jatropha oil is Jatropha curcas. The seeds are the primary source from which the oil is extra acted. Owing to the toxicity of jatropha seeds, they are not used by humans. The major goal of jatropha cultivation, therefore, is performed for the sake of extracting jatropha oil.Analysis of jatropha curcus seed shows the following chemical compositions: -

Moisture: 6.20%
Protein: 18.00%
Fat: 38.00%
Carbohydrates: 17.00%
Fiber: 15.50%
Ash: 5.30%

The oil content is 25-30% in the seed. The oil contains 21% saturated fatty acids and 79% unsaturated fatty acids. These are some of the chemical elements in the seed, cursing, which is poisonous and render the oil not appropriate for human consumption. Oil has very high saponification value and being extensively used for making soap in some countries.

Also, oil is used as an illuminant in lamps as it burns without emitting smoke. It is also used as fuel in place of, or along with kerosene stoves. Jatropha curcus oil cake is rich in

Nitrogen, Phosphorous and Potassium and can be used as organic manure. Thermodynamic conversion process, pyrolysis, useful products can be obtained from the jatropha oil cake.

The liquid, solid (char), and gaseous products can be obtained. The liquid can be used as fuel in furnace and boiler. It can be upgraded to higher grade fuel by transesterification process.

It is significant to point out that, the non-edible vegetable oil of jatropha curcus has the requisite potential providing a promising and commercially viable alternative to diesel oil since it has desirable physical chemical and performance characteristics comparable to diesel. Cars could be run with jatropha curcus without requiring much change in design. Jatropha oil expelled from seeds and filtered through filter press can replace kerosene or oil lamp. Jatropha oil can be used as liquid fuel for lighting and cooking. It will also be used in big Diesel engine- based electricity generating sets, pump sets, heavy farm machinery, where the viscosity of oil isnot an issue.

The seeds of jatropha contain (50% by weight) viscous oil which can be used for manufacture of candles and soap, in the cosmetic industry, for cooking and lighting by itselfor as a Diesel /paraffin substitute or extender. The latter use has important implications for meeting the demand for rural energy services and also exploring practical substitute for fossil fuels to counter greenhouse gas accumulation in the atmosphere.

Jatropha curcus as an energy source: Oil from jatropha curcus: There are number of variety of jatropha. Best among these are jatropha curcus. Jatropha oil is an important product from the plant for meeting the cooking and lighting needs of the rural population, boiler fuel for industrial purpose or as a viable substitute for Diesel.

About one- third of the energy in the fruit of jatropha can be extracted as oil that has a similar energy value to Diesel fuel. Jatropha oil can be used directly in Diesel engines added to Diesel fuel as an extender or transesterified to a bio-diesel fuel. There are some technical problems to using jatropha oil directly in Diesel engines that have yet to be completely overcome.

Moreover, the cost of producing jatropha oil as a Diesel substitute is currently higher than the cost of Diesel itself.

Use as jet fuel: Aviation fuels may be more widely substituted with biofuels such as jatropha oil than fuels for other forms of transportation. On December 30, 2008, Air New Zealand flew the first successful test flight with a Boeing 747 running one of its four Rolls-Royce engines on a 50:50 blend of jatropha oil and jet A-1 fuel. Subsequently, Air New Zealand and Houston based Continental Airlines have run tests in Jan. 2009, further demonstrating the viability of jatropha oil as a jet fuel.

3) MATERIAL AND METHODS

3.1. Material.

Materials and apparatus used in the production of the biodiesel are as follows**:-**
thermometer, retort stand, pipette, measuring cylinder, separating funnel, magnetic stirrer, oven, conical flask, digital weighing balance, stop watch, hot plate, distilled water, methanol, and jatropha oil.

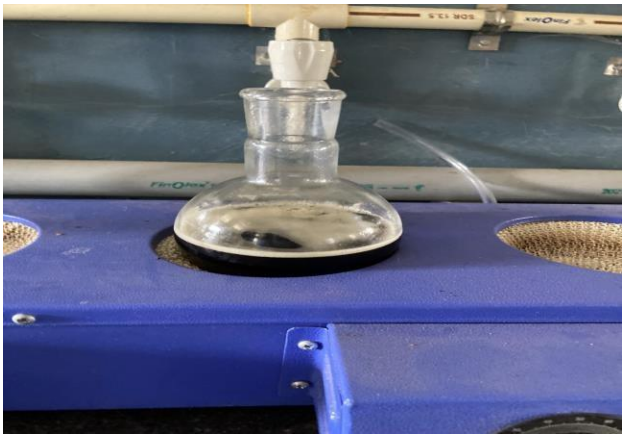
3.2. Methods.

Steps in biodiesel production: two steps are used in the production of the biodiesel as followed by :-

(i) Transesterification.:-

The step by step approach used in the production of the biodiesel is given below.

(i) 150 mL of jatropha oil was measured and poured into 250 mL conical flask and heated to a temperature of 60°C. See in fig 1



(Fig 1) preheating of jatropha oil

(ii) A 100mL of methanol was poured in a round bottom flask and soxhlet apparatus, and the heater was turned on. This was done to purify the methanol.

(iii) The sodium hydroxide pellet was placed in the weighing balance to get exactly 2.5 g.

(iv) sodium hydroxide pellet is dissolved in the methonal to make it a solution(fig 2)

Fig (2) mixing of NaOH and methanol

(v) The dissolved mixture in a separate vessel and was poured into the heated jatropha oil round in bottom flask while stirring the mixture continuously. The mixture was maintained at atmospheric pressure and 60°C for 60 minutes.

(vi) After completion of transesterification process, the mixture is allowed to settle under gravity for 24 hours in a separating funnel. (Fig3)

Fig (3) separation

(vii) The products formed during transesterification were Jatropha oil methyl ester and Glycerin.

(viii) The bottom layer consists of Glycerin, excess alcohol, catalyst, impurities and traces of unreacted oil. The upper layer consists of biodiesel, alcohol and some soap

(ix) After separation of glycerin we will get the biodiesel (fig 4)

(x) After filter we will get purified biodiesel (fig 5)

Fig (4) separated oil

fig (5) pure bio diesel

3.3. Analytical methods.

Determination of Specific Gravity :-

Density bottle was used to determine the density of the oil. A clean dry bottle of 25 mL was weighed (w0) and then filled with the oil; a stopper was inserted and then reweighed to give (w1). The oil substituted with water after washing and drying and weighed to give (w2) as

Specific gravity :- (w1-w0)/(w2-w0)

Determination of Moisture Content :-

Procedure. The oil sample was weighed and the mass taken as (w1) thus was then dried in the oven and the weight after drying was taken as (w2). The percentage moisture in the oil was then calculated using the formula below:

$$\%\text{moisture content} = (w1-w2)/w1 *100$$

Flash point: 150 ml of blended oils was poured into a metal container and heated at a controlled rate over certain temperature after, which, the flame being passed over the surface of the blend -ed oils was observed at a regular intervals of 5 secs for 1 min. The flash point was determined.

Flame point :- 150 ml of blended oils was poured into a metal container and heated at a control rate over certain temperature after, where the continuous flame being observed over the surface of the blended oils was observed at a regular intervals of 5 secs for 1 min. The flame point was determined.

Determination of Saponification Value :-

Procedure:- The oil sample was filtered to remove any impurities and last traces of moisture. 5 g of the sample was then weighed into a flask and 5 mL of alcoholic KOH was added from burette allowing it to drain for the same duration of time. A reflux condenser was connected to the flasks and allowed to boil gently for one hour. After the flask and condenser get cooled, they are rinsed down the inside of the condenser with a little distilled water and then the condenser was removed About 1 mL of indicator was added and titrated against 0.5 m HCL until the pink colour vanish.

4 RESULT AND DISCUSSION

4.1. Characterization:

S.NO	PROPERTIES	UNITS	RESULTS
1	Specific gravity	Kg/L	0.88
2	Flash point	°F	48
3	Total glycerin	% mass	% 0.22
4	Saponification	mg KOH/g	190
5	Flame point	°F	72
6	Moisture content		0.20
7	PH		5.62
8	Density	g/cc	0.875

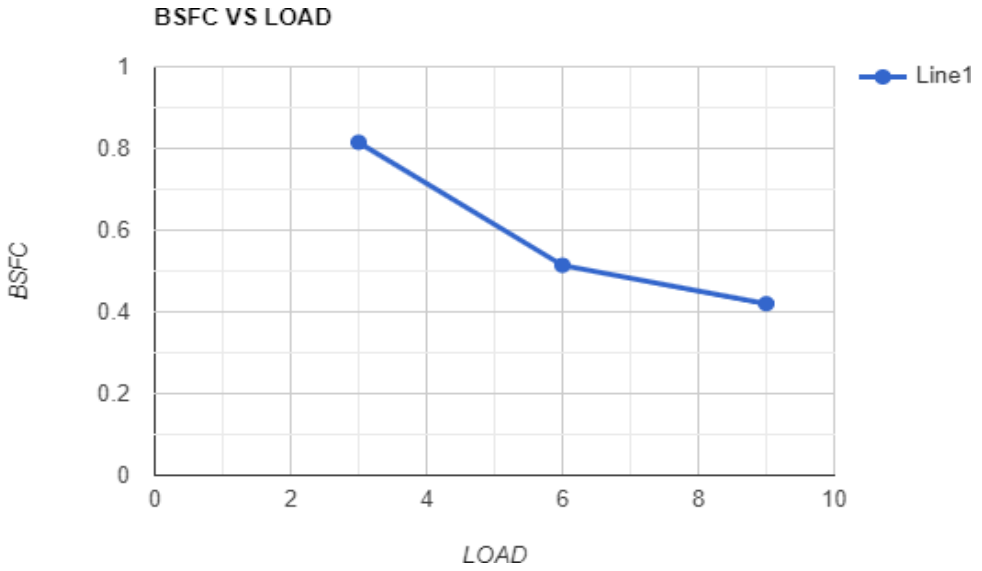
4.2. Results/Optimizations

Engine Peífoímance :-

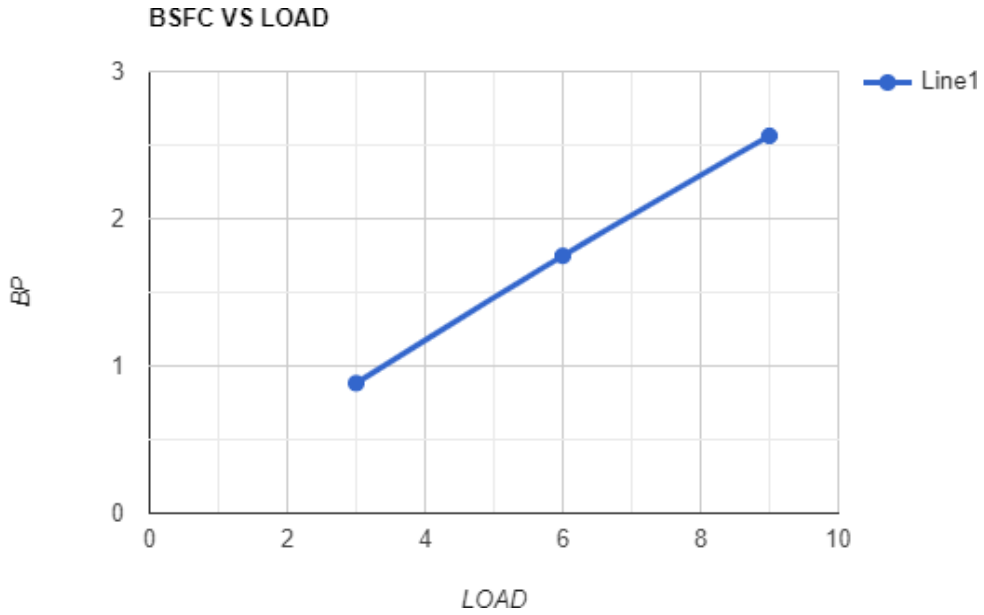
BASED ON DIESEL

S.NO	LOAD	SPEED	TIME	BSFC	BTH	BP
1	3 KG	1500	40 SEC	0.815	10.03%	0.883 KW
2	6 KG	1500	33 SEC	0.514	15.89%	1.748 KW
3	9 KG	1500	26 SEC	0.42	19.146%	2.563 KW

BSFC VS LOAD



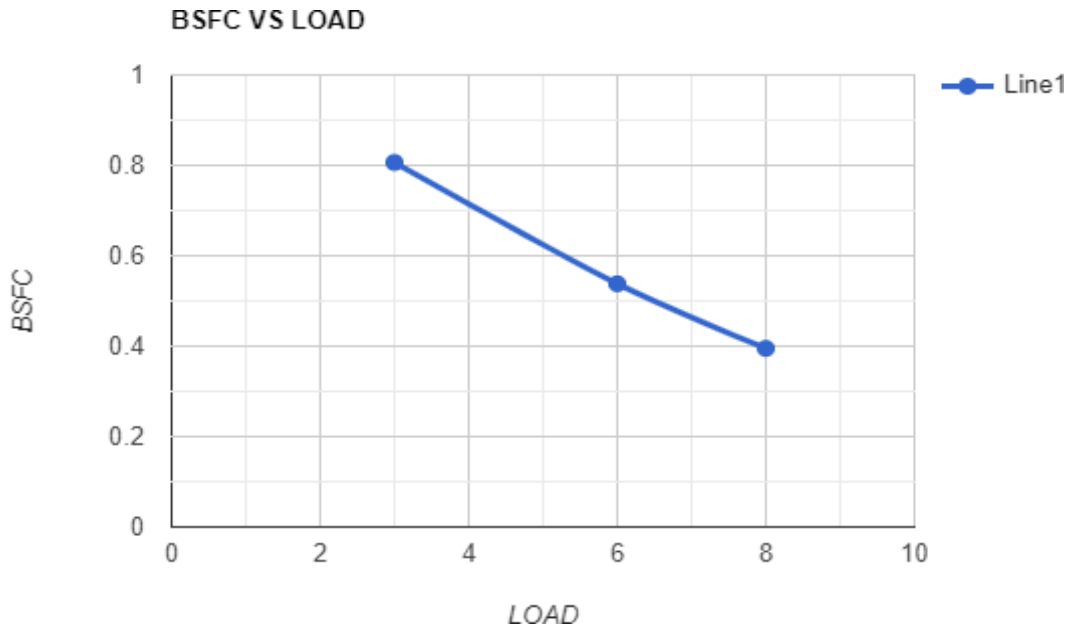
BP VS LOAD :-



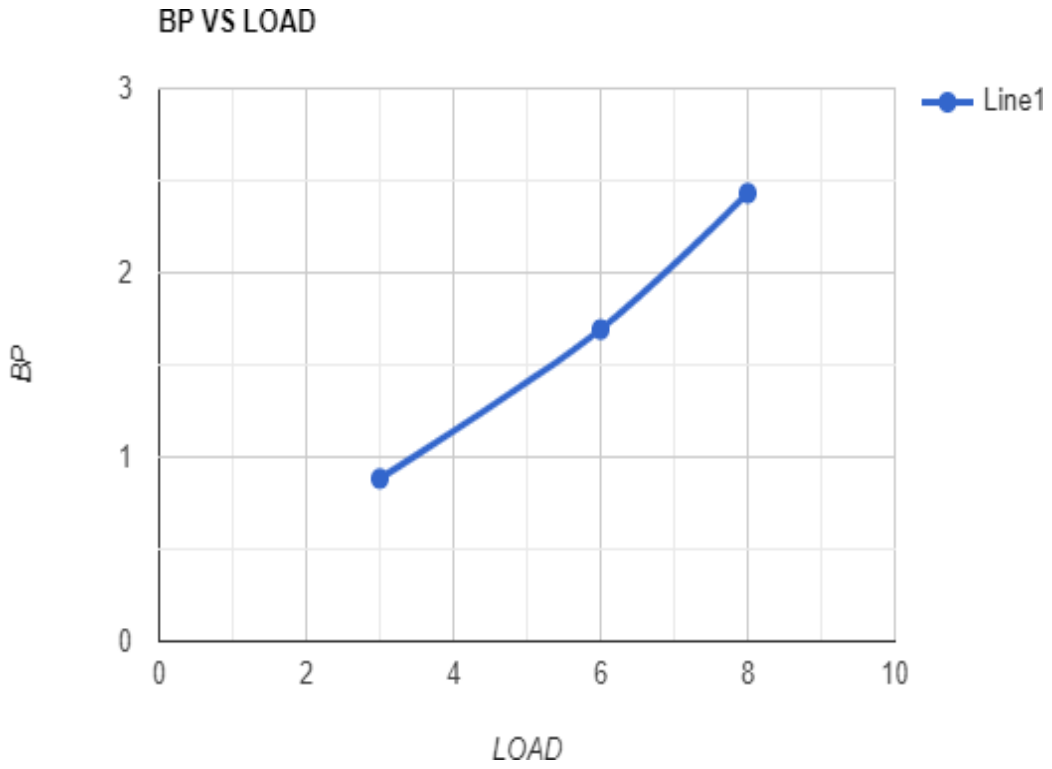
BASED ON BIODIESEL :-

S.NO	LOAD	SPEED	TIME	BSFC	BTH	BP
1	3 KG	1500	45.98 SEC	0.8064	10.14%	0.883 KW
2	6 KG	1500	34.75 SEC	0.538	15.14%	1.692KW
3	8 KG	1500	29 SEC	0.395	18.5%	2.423 KW

BSFC VS LOAD :-



BP VS LOAD :-



4.3. Comparatively study:

PROPERTIES	DIESEL	JATROPHA OIL	BIODIESEL
FLASH POINT	65	115	48
FLAME POINT	70	142	72
SPECIFIC GRAVITY	0.793	0.944	0.88
DENSITY	0.85	0.926	0.875

5 CONCLUSION AND RECOMMENDATION

5.1. Conclusion:

In the current investigation, it has confirmed that jatropha oil may be used as resource to obtain biodiesel. The experimental result shows that alkaline-catalyzed transesterification is a promising area of research for the production of biodiesel in large scale. Materials for use in the production of biodiesel are readily available without the need for special equipment or scarce chemicals. Effects of different parameters such as temperature, time, reactant ratio, and catalyst concentration on the biodiesel yield were analyzed. The best combination of the parameters was found as 8 : 1 molar ratio of methanol to oil, 1.0% KOH catalyst, 60°C reaction temperature and 60 minutes of reaction time. This optimum condition yielded 90% of biodiesel. The viscosity of Jatropha oil reduces substantially after transesterification and is comparable to diesel. Biodiesel characteristics like density, flash point, specific gravity are comparable to diesel.

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A

FIELD PROJECT REPORT

ON

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Submitted in the partial fulfillment of the requirements for the award of the degree
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DEC-2022

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I would like to thank my guide **Dr. P. Vijetha,** Vignan'**s** foundation for science technology and research, Vadlamudi. The interaction with her was really fruitful and helped me in compiling this project report. My deepest thanks to Dr. M. Ramesh Naidu Head of Chemical Department VFSTR, Vadlamudi for guiding me and extending all possible help to me and always inspiring me to do my work on this project report with sincerity. Also, I would like to thank whose Dr. M. Ramesh Naidu trust and enthusiasm was constant motivation during ongoing work. Last but not least I would like to be thankful to all staff members of the Department of Chemical Engineering, Vignan University, Vadlamudi and those who directly or indirectly helped me in the completion of this project report.

UNDERTAKING

This is to declare that the project entitled "**Production of Biodiesel from Waste Cooking Oil and Testing Its Efficiency in Four Stroke Single Cylinder Engine**" is an originalwork done by undersigned, in partial fulfillment the requirements for the degree "Bachelor of Technology" from Department of Chemical Engineering

All the analysis, design and system development have been accomplished by the undersigned.Moreover, this project has not been submitted to any other college or university.

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CERTIFICATE

This is to certify that the field project entitled as, **"Production of Biodiesel from Waste Cooking Oil and Testing Its Efficiency in Four Stroke Single Cylinder Engine"** submitted by 211FA02005, 211FA02006, 211FA02008, 221LA02001, 221LA02006 to the Vignan's Foundation for Science, Technology and Research (Deemed to be University), Guntur, Andhra Pradesh for the award of the degree of Bachelor of Technology is a bonafide record of the research work done by him/her under my supervision. The contents of this thesis, in full or in part, have not been submitted to any other institute or university for the award of any Degree.

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ABSTRACT

Biodiesel, a promising substitute as an alternative fuel, has gained significant attention due to the predicted shortness of conventional fuels and environmental concerns. The utilization of liquid fuels such as biodiesel produced from Waste cooking oil by transesterification process represents one of the most promising options for the use of conventional fossil fuels. The Waste cooking oil is converted into Waste cooking oil methyl ester known as bio- diesel prepared in the presence of homogeneous acid catalyst. The physical properties such as density, flash point, Kinematic viscosity, Cloud point and Pour point were found out for Waste cooking oil and Jatropha methyl ester. The same characteristics study was also carried out for the diesel fuel for obtaining the base line data for analysis. The value obtained from the Jatropha methyl ester is closely matched with the values of conventional diesel and can be used in the existing diesel engine without any modification.

Keywords: transesterification, biodiesel

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1. INTRODUCTION

Biodiesel is an alternative fuel made from renewable biological sources such as vegetable oils both (edible and non edible oil) and animal fats. Vegetable oils are usually ester glycol with diffe -rential chain length and degree of saturation. It may be seen that vegetable contains substantial amount of oxygen in their molecules. Practically the high viscosity of vegetable oils (30- 200 Centistokes)as compared to that to Diesel (5.8- 6.4 Centistokes) leads to oils unfavorable pump, inefficient mixing of fuel with air contributes incomplete combustion, high flash point result in increased carbon deposit formation and inferior coking. Due to these problems, vegetable oil needs to be modified to bring the combustion related properties closer to those of Diesel oil. The fuel modification is mainly aimed at reducing the viscosity and increasing the volatility. One of the most promising processes to convert vegetable oil into methyl ester is the transesterification, in which alcohol reacts with triglycerides of fatty acids (vegetable oil) in the presence of catalyst. Jatropha vegetable oil is one of the prime non edible sources available in India. The vegetable oilused for biodiesel production might contain free fatty acids which will enhance saponification reaction as side reaction during the transesterification process.

All countries are at present heavily dependent on petroleum fuels for transportation and agricultural machinery. The fact that a few nations together produce the bulk of petroleum has led to high price fluctuation and uncertainties in supply for the consuming nations. This in turn has led them to look for alternative fuels that they themselves can produce. Among the alternatives being considered are methanol, ethanol, biogas and vegetable oils. Vegetable oils have certain features that make them attractive as substitute for Diesel fuels.
Vegetable oil has the characteristics compatible with the CI engine systems. Vegetable oils are also miscible with diesel fuel in any proportion and can be used as extenders. India highly depends on import of petroleum crude and nearly two third of its requirement is met through imports. Moreover the gases emitted by petrol, diesel driven vehicles have an adverse effect on the environment and human health.

2. LITERATURE REVIEW

Introduction to work **2.1 Mechanism**

2.1.1 **Transesterification**:

Is the process of chemically reacting a fat or oil with an alcohol in a presence of a catalyst. Alcohol used is usually methanol or ethanol Catalyst is usually sodium hydroxide or potassium hydroxide. The main product of transesterification is biodiesel and the co-product is glycerin

2.2 Reaction :-

Neutralization: The vegetable oil contains about 14- 19.5 % free fatty acids in nature, it must be freed before taken into actual conversion process. The presence of about 14% of free fatty acid makes Waste cooking oil inappropriate for industrial biodiesel production.

The dehydrated oil is agitated with 4 % HCl solution for 25 minutes and 0.82 gram of NaOH was added per 100 ml of oil to neutralize the free fatty acids and to coagulate by the following reaction. $RCOOH + NaOH \rightarrow RCOONa + H_2O$ The coagulated free fatty acid (soap) is removed by filtration. This process brings the free fatty acid content to below 2 % and is perfect source for biodiesel production

2.3 Parameter to be consider :-

SNO	PARAMEI'ERS	OPTIMIZATION CONDITIONS
1	catalyst amount	2.5 GRAMS
2	tempeíatuíe	60-70 C
3	íeaction time	60-90 minutes
4	methanol/oil íatio,	1:1.5
5	biodiesel yield	100ML

Factor effecting

Scarcity, insecurity, and severe environmental impact of fossil fuel-based energy consumption have enthused the production and utilization of alternative energy resources. Biodiesel is identified as promising renewable energy that can substitute the petrol diesel consumption with numerous advantages. However, more than 95% of biodiesel is produced from edible oil crops, which jeopardizes the food supplies. As a result, exploring inexpensive and non-edible oilbearing energy crops such as jatropha *curcas* (Jatropha) has been the target of governments, researchers, industries, and policymakers.

However, sustainable biodiesel production from this plant is not achieved yet due to various ecological, socioeconomic, legislative, and technological factors. Previous reports showed that the individual impact of those factors; however, all factors are strongly correlated, and the impact of one factor is significantly affected by the situation of other factors. Therefore, the present review is devoted to critically examine and discuss the sole and interactive effect of various factors affecting the cultivation of Jatropha for sustainable biodiesel production by reviewing more than 185 published articles.

Various oil extraction and biodiesel production technologies and factors affecting the physicochemical properties of Waste cooking oil and biodiesel were profoundly investigated. Moreover, the performance, combustion, and emission characteristic of diesel engines fuelled with Jatropha biodiesel were carefully reviewed and compared with petrol diesel. In conclusion, factors affecting the sustainable biodiesel production potential of Jatropha vary across growing regions due to variation in determinants, and the performance and emission characteristic of diesel engines fueled with Jatropha biodiesel slightly differed from petrol diesel.

Source of Waste cooking oil: The plant that is generally cultivated for the purpose of extracting Waste cooking oil is Jatropha curcas. The seeds are the primary source from which the oil is extra acted. Owing to the toxicity of jatropha seeds, they are not used by humans. The major goal of jatropha cultivation, therefore, is performed for the sake of extracting Waste cooking oil.Analysis of jatropha curcus seed shows the following chemical compositions: -

Moisture: 6.20%
Protein: 18.00%
Fat: 38.00%
Carbohydrates: 17.00%
Fiber: 15.50%
Ash: 5.30%

The oil content is 25-30% in the seed. The oil contains 21% saturated fatty acids and 79% unsaturated fatty acids. These are some of the chemical elements in the seed, cursing, which is poisonous and render the oil not appropriate for human consumption. Oil has very high saponification value and being extensively used for making soap in some countries.

Also, oil is used as an illuminant in lamps as it burns without emitting smoke. It is also used as fuel in place of, or along with kerosene stoves. Jatropha curcus oil cake is rich in Nitrogen,

Phosphorous and Potassium and can be used as organic manure. Thermodynamic conversion process, pyrolysis, useful products can be obtained from the Waste cooking oil cake.

The liquid, solid (char), and gaseous products can be obtained. The liquid can be used as fuel in furnace and boiler. It can be upgraded to higher grade fuel by transesterification process.

It is significant to point out that, the non-edible vegetable oil of jatropha curcus has the requisite potential providing a promising and commercially viable alternative to diesel oil since it has desirable physical chemical and performance characteristics comparable to diesel. Cars could be run with jatropha curcus without requiring much change in design. Waste cooking oil expelled from seeds and filtered through filter press can replace kerosene or oil lamp. Waste cooking oil can be used as liquid fuel for lighting and cooking. It will also be used in big Diesel enginebased electricity generating sets, pump sets, heavy farm machinery, where the viscosity of oil is not an issue.

The seeds of jatropha contain (50% by weight) viscous oil which can be used for manufacture of candles and soap, in the cosmetic industry, for cooking and lighting by itself or as a Diesel /paraffin substitute or extender. The latter use has important implications for meeting the demand for rural energy services and also exploring practical substitute for fossil fuels to counter greenhouse gas accumulation in the atmosphere.

Jatropha curcus as an energy source: Oil from jatropha curcus: There are number of variety of jatropha. Best among these are jatropha curcus. Waste cooking oil is an important product from the plant for meeting the cooking and lighting needs of the rural population, boiler fuel for industrial purpose or as a viable substitute for Diesel.

About one- third of the energy in the fruit of jatropha can be extracted as oil that has a similar energy value to Diesel fuel. Waste cooking oil can be used directly in Diesel engines added to Diesel fuel as an extender or transesterified to a bio-diesel fuel. There are some technical problems to using Waste cooking oil directly in Diesel engines that have yet to be completely overcome.

Moreover, the cost of producing Waste cooking oil as a Diesel substitute is currently higher than the cost of Diesel itself.

Use as jet fuel: Aviation fuels may be more widely substituted with biofuels such as Waste cooking oil than fuels for other forms of transportation. On December 30, 2008, Air New Zealand flew the first successful test flight with a Boeing 747 running one of its four Rolls-Royce engines on a 50:50 blend of Waste cooking oil and jet A-1 fuel. Subsequently, Air New Zealand and Houston based Continental Airlines have run tests in Jan. 2009, further demonstrating the viability of Waste cooking oil as a jet fuel.

3) MATERIAL AND METHODS

3.1. Material.

Materials and apparatus used in the production of the biodiesel are as follows**:-** thermometer, retort stand, pipette, measuring cylinder, separating funnel, magnetic stirrer, oven, conical flask, digital weighing balance, stop watch, hot plate, distilled water, methanol, and Waste cooking oil.

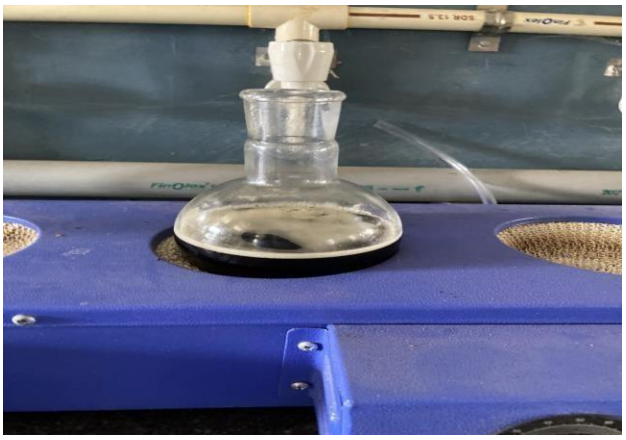
3.2. Methods.

Steps in biodiesel production: two steps are used in the production of the biodiesel as followed by :-

(i) Transesterification.:-

The step by step approach used in the production of the biodiesel is given below.

(i) 150 mL of Waste cooking oil was measured and poured into 250 mL conical flask and heated to a temperature of 60°C. See in fig 1



(Fig 1) preheating of Waste cooking oil

(ii) A 100mL of methanol was poured in a round bottom flask and soxhlet apparatus, and the heater was turned on. This was done to purify the methanol.

(iii) The sodium hydroxide pellet was placed in the weighing balance to get exactly 2.5 g.

(iv) sodium hydroxide pellet is dissolved in the methonal to make it a solution(fig 2)

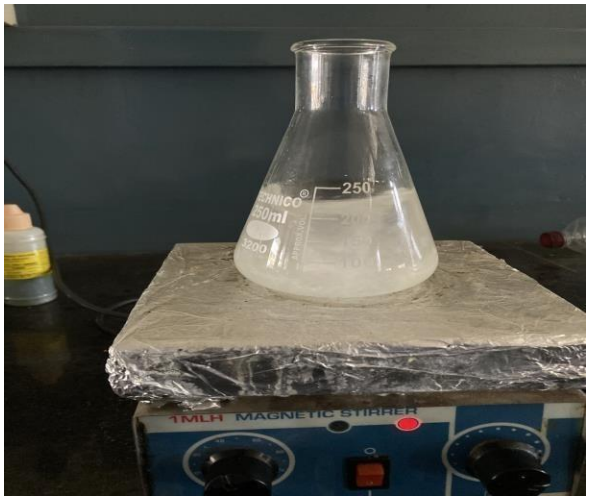


Fig (2) mixing of NaOH and methanol

(v) The dissolved mixture in a separate vessel and was poured into the heated Waste cooking oil round in bottom flask while stirring the mixture continuously. The mixture was maintained at atmospheric pressure and 60°C for 60 minutes.

(vi) After completion of transesterification process, the mixture is allowed to settle under gravity for 24 hours in a separating funnel. (Fig3)

Fig (3) separation

(vii)The products formed during transesterification were Waste cooking oil methyl esterand Glycerin.

(viii) The bottom layer consists of Glycerin, excess alcohol, catalyst, impurities and traces of unreacted oil. The upper layer consists of biodiesel, alcohol and some soap

(ix) After separation of glycerin we will get the biodiesel (fig 4)

(x) After filter we will get purified biodiesel (fig 5)

Fig (4) separated oil

fig (5) pure bio diesel

3.3. Analytical methods.

Determination of Specific Gravity :-

Density bottle was used to determine the density of the oil. A clean dry bottle of 25 mL was weighed (w0) and then filled with the oil; a stopper was inserted and then reweighed to give (w1). The oil substituted with water after washing and drying and weighed to give (w2) as Specific gravity :- (w1-w0)/(w2-w0)

Determination of Moisture Content :-

Procedure. The oil sample was weighed and the mass taken as (w1) thus was then dried in the oven and the weight after drying was taken as (w2). The percentage moisture in the oil was then calculated using the formula below:

$$\%\text{moisture content} = (w1-w2)/w1 * 100$$

Flash point: 150 ml of blended oils was poured into a metal container and heated at a controlled rate over certain temperature after, which, the flame being passed over the surface of the blend -ed oils was observed at a regular intervals of 5 secs for 1 min. The flash point was determined.

Flame point :- 150 ml of blended oils was poured into a metal container and heated at a control rate over certain temperature after, where the continuous flame being observed over the surface of the blended oils was observed at a regular intervals of 5 secs for 1 min. The flame point was determined.

Determination of Saponification Value :-

Procedure:- The oil sample was filtered to remove any impurities and last traces of moisture. 5 g of the sample was then weighed into a flask and 5 mL of alcoholic KOH was added from burette allowing it to drain for the same duration of time. A reflux condenser was connected to the flasks and allowed to boil gently for one hour. After the flask and condenser get cooled, they are rinsed down the inside of the condenser with a little distilled water and then the condenser was removed About 1 mL of indicator was added and titrated against 0.5 m HCL until the pink colour vanish.

4 RESULT AND DISCUSSION

4.1. Characterization:

S.NO	PROPERTIES	UNITS	RESULTS
1	Specific gravity	Kg/L	0.88
2	Flash point	°F	48
3	Total glycerin	% mass	% 0.22
4	Saponification	mg KOH/g	190
5	Flame point	°F	72
6	Moisture content		0.20
7	PH		5.62
8	Density	g/cc	0.875

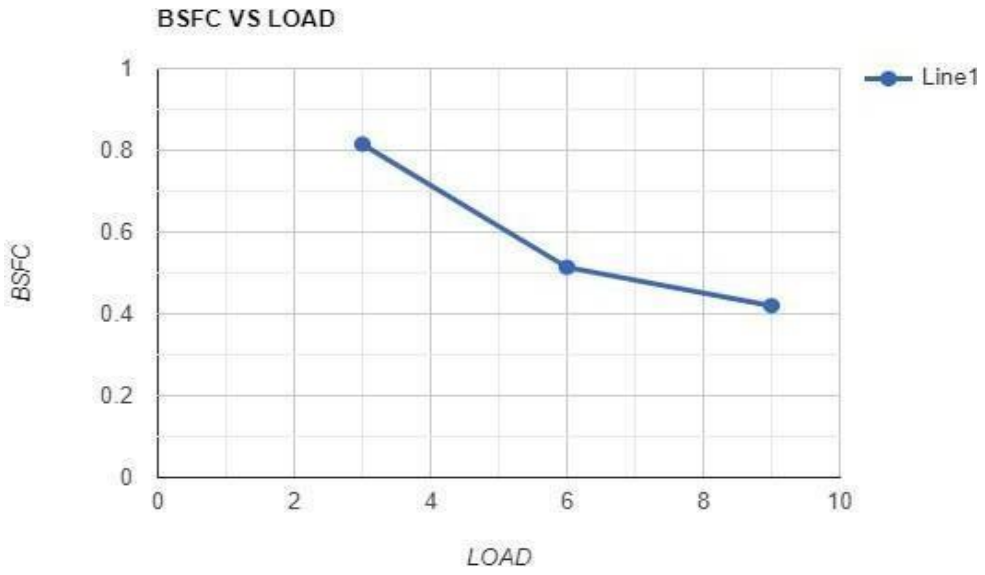
4.2. Results/Optimizations

Engine Peífoímance :-

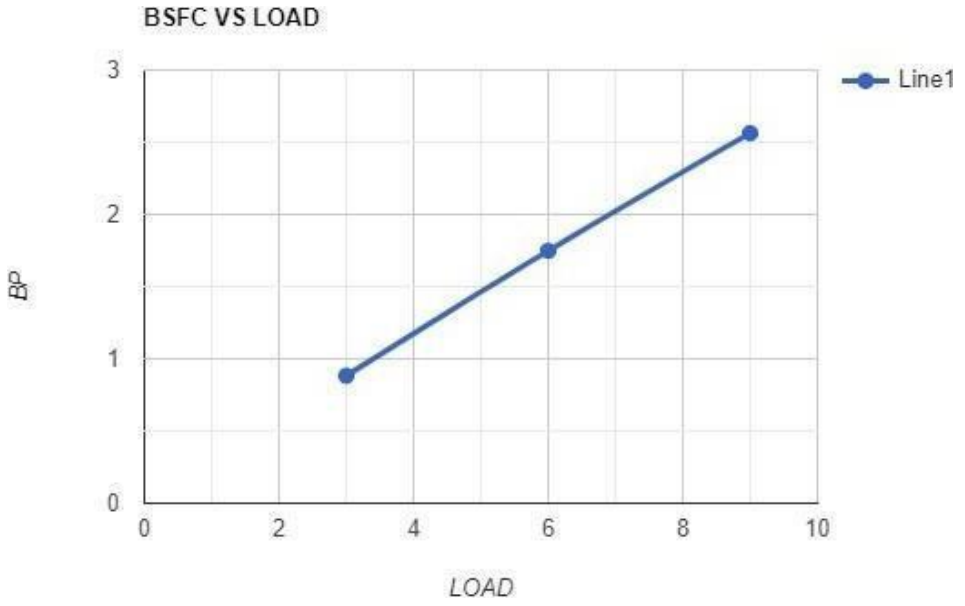
BASED ON DIESEL

S.NO	LOAD	SPEED	TIME	BSFC	BTH	BP
1	3 KG	1500	40 SEC	0.815	10.03%	0.883 KW
2	6 KG	1500	33 SEC	0.514	15.89%	1.748 KW
3	9 KG	1500	26 SEC	0.42	19.146%	2.563 KW

BSFC VS LOAD



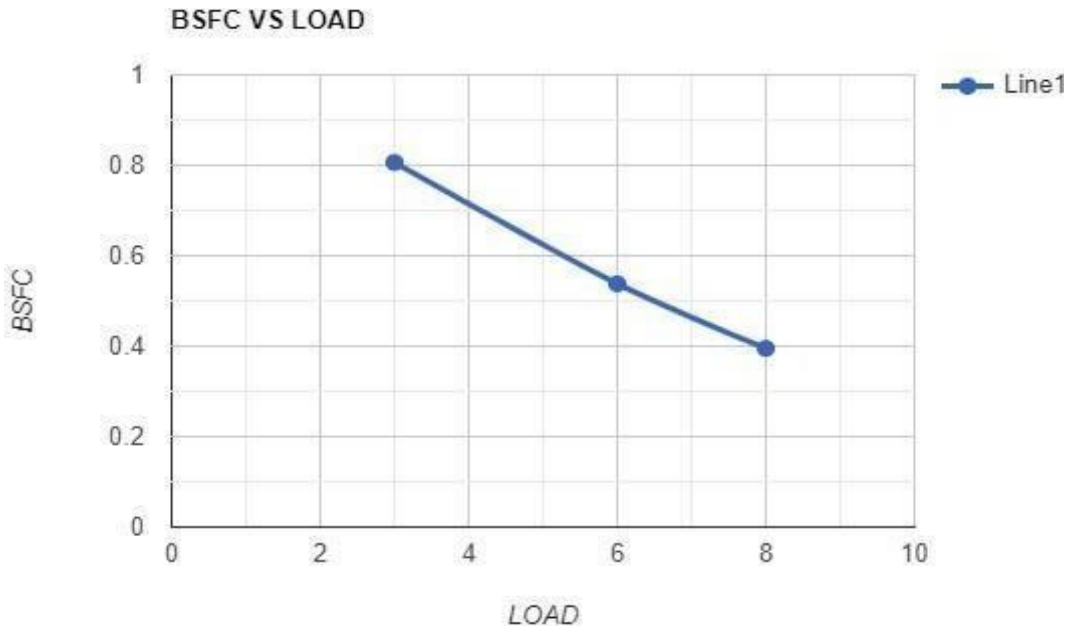
BP VS LOAD :-



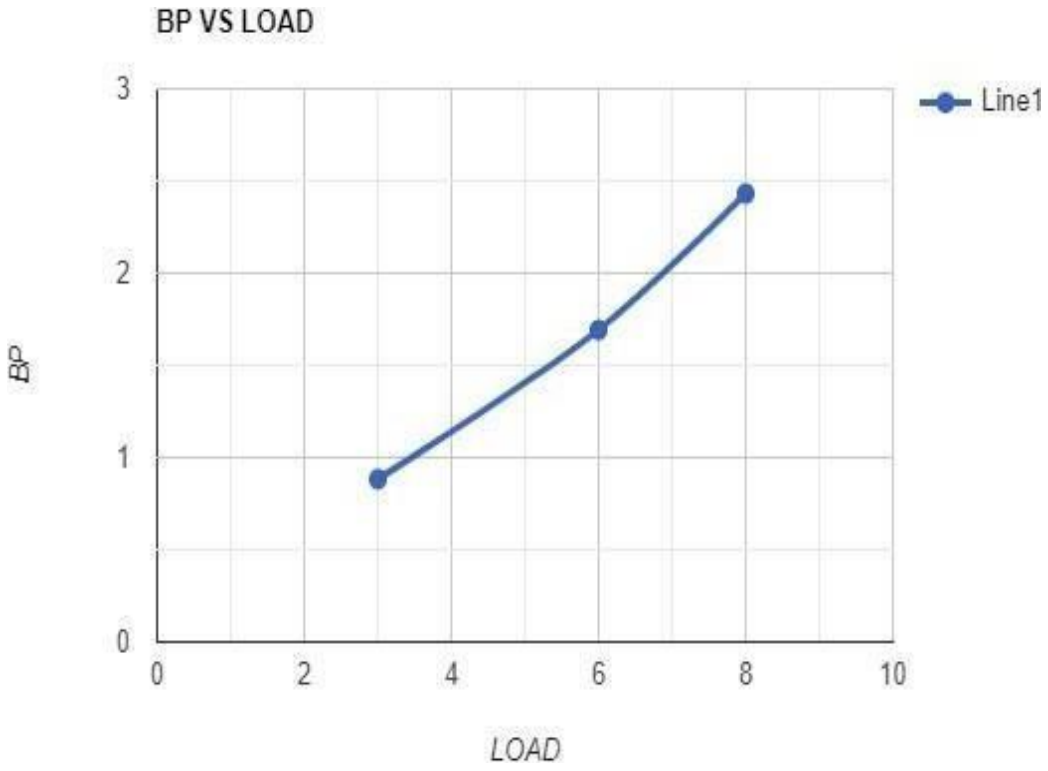
BASED ON BIODIESEL :-

S.NO	LOAD	SPEED	TIME	BSFC	BTH	BP
1	3 KG	1500	45.98 SEC	0.8064	10.14%	0.883 KW
2	6 KG	1500	34.75 SEC	0.538	15.14%	1.692KW
3	8 KG	1500	29 SEC	0.395	18.5%	2.423 KW

BSFC VS LOAD :-



BP VS LOAD :-



4.3. Comparatively study:

PROPERTIES	DIESEL	WASTE COOKING OIL	BIODIESEL
FLASH POINT	65	115	48
FLAME POINT	70	142	72
SPECIFIC GRAVITY	0.793	0.944	0.88
DENSITY	0.85	0.926	0.875

5 CONCLUSION AND RECOMMENDATION

5.1. Conclusion:

In the current investigation, it has confirmed that Waste cooking oil may be used as resource to obtain biodiesel. The experimental result shows that alkaline-catalyzed transesterification is a promising area of research for the production of biodiesel in large scale. Materials for use in the production of biodiesel are readily available without the need for special equipment or scarce chemicals. Effects of different parameters such as temperature, time, reactant ratio, and catalyst concentration on the biodiesel yield were analyzed. The best
combination of the parameters was found as 8 : 1 molar ratio of methanol to oil, 1.0% KOH catalyst, 60°C reaction temperature and 60 minutes of reaction time. This optimum condition yielded 90% of biodiesel. The viscosity of Waste cooking oil reduces substantially after transesterification and is comparable to diesel. Biodiesel characteristics like density, flash point, specific gravity are comparable to diesel.

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A

FIELD PROJECT REPORT

ON

EXTRACTION OF CAPSAICIN OLEORESIN FROM RED CHILLIES

Submitted in the partial fulfillment of the requirements for the award of the degree

BACHELOR OF TECHNOLOGY

In

Department of Chemical Engineering

VIGNAN'S
Foundation for Science, Technology & Research
(Deemed to be UNIVERSITY)
-Estd. u/s 3 of UGC Act 1956

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UNDERTAKING

This is to declare that the project entitled "**Extraction of capsaicin oleoresin from red chillies**" is an original work done by undersigned, in partial fulfillment of the requirements for the degree "Bachelor of Technology in Chemical Engineering .

All the analysis, design and system development have been accomplished by the undersigned. Moreover, this project has not been submitted to any other college oruniversity.

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CERTIFICATE

This is to certify that the field project entitled as, ""**EXTRACTION OF CAPSAICIN OLEORESIN FROM RED CHILLIES**" submitted by 211FA02007, 211FA02011, 221LA02002, 221LA02005, 221LA02009 to the Vignan's Foundation for Science, Technology and Research (Deemed to be University), Guntur, Andhra Pradesh for the award of the degree of Bachelor of Technology is a bonafide record of the research work done by him/her under my supervision. The contents of this thesis, in full or in part, have not been submitted to any other institute or university for the award of any Degree.

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ABSTRACT

Capsaicin is a valuable compound found in *Capsicum annuum*. Oleoresins are flavored compounds found in a wide variety of plants, spices, and flowers. Oleoresins are more consistent, stable, and easier to handle and store. Among them, chilli oleoresins are commonly used in the food-processing industry. Compared to other countries, chilli is widely produced in India, which led us to choose chili for the oleoresin extraction. The oleoresin of capsicum annuum i.e., red chillies, is more readily available than solid red chillies. Approximately 60% of the world's chilli production is transformed into oleoresin. It is more sustainable to use liquid form of chilli rather than solid form. Spices are extracted from Soxhlet extractions and steam distillations to yield oleoresins. The oleoresin form is more concentrated than the natural form. Scoville scale values indicate that the spice level of red chilli oleoresin will increase .The present study aimed to explore the efficiency of different solvents on its extraction by different methods. Blend of (n-hexane and acetone) was found to be the best solvent followed by n-hexane and blend of (n-hexane and ethanol), respectively. Efficient method is ultra-sonification followed by soaking method and Soxhlet extraction. For that different type of chillies are used.

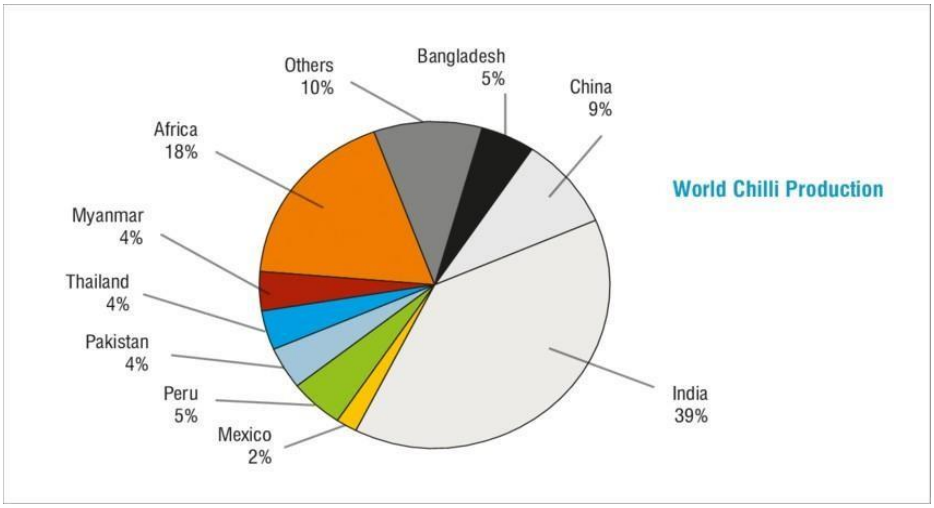
Keywords: Capsicum Annuum, Oleoresin, Extracts, Soxhlet, ultrasonic -assisted

1. INTRODUCTION

Capsicum annuum, the scientific name for chilies, belongs to the Solanaceae family. Each of the 400 varieties on the Scoville scale is ranked according to its pungency. Red chilli powder is formed when dried and ripened chilli fruits are ground into powder. It is referred to as a hot pepper. In 1492, Christopher Columbus recognized this red chilli as a pepper due to its colour and pungency, and therefore named it red pepper. The red chilli is one of the fastest growing crops in the world; it is native to Asia, Africa and India's south-east, like Andhra Pradesh, Madhya Pradesh, and Maharashtra.

Chilies are classified into different types, such as sweet chillies, baby chillies, Jalapeno chillies, green chillies, bell peppers, Mexican hot chillies. They contain a compound called carotenoids, which is responsible for their colour.

Over the past few years, chill production has increased throughout the world. Using the pie chart below, you can see how much chilli is produced around the world.



A red chilli has a spiciness of less than 30,000 Scoville units. Naga jolokia is cultivated in Assam regions and is the hottest chilli in the world. The oleoresin in dried red chillies is extracted through the Soxhlet method, which has a Scoville value above that of capsicum annuum. We chose S17 grade chillies among the several available grades due to their high capsaicin content.

Balsams are naturally derived oleoresins that are liquid extracts derived from resins. The traditional methods of our ancestors for cooking were done using general methods before the discovery of oleoresin. Compared to essential oils, oleoresins produce a stronger flavor and are 5- 20 times stronger than spices. In finished products, oleoresins are present in small amounts of approximately 0.1-0.5%.

There are both volatile and non-volatile compounds in oleoresins. Approximately 70% of the total oleoresin production comes from India. Oleoresin is produced using a variety of methods such as steam distillation, Soxhlet extraction, and by mechanical means. Soxhlet extraction, Soaking method and Ultrasonic assisted extraction was the processess had chosen for project since they were simple, economical, and efficient.

A variety of health benefits are associated with chilli oleoresin. Various ailments, including headaches, joint pain, postherpetic neuralgia, and mouth sores, can be treated with these spicy oleoresins. Essentially, these are natural products made of a complex mixture of lipophilic molecules, which are rich in bioactive compounds. Oleoresins are expensive to produce because they require several steps such as extraction, vacuum distillation, and solvents. cocncentrations of oleoresin capsaicin has been examined based on extraction methods and solvents blend.

Despite high antioxidant activity, low contact angles, and high-water solubility, all formulations exhibited high antioxidant activity. There were no adverse effects observed in the experimental assay, nor any change in hepatic aminotransferase levels. Comparing a microparticle-supplemented High-Fat Diet (HFD) with a HFD control, capsicum oleoresin decreased weight gain. (Ana Gabriela da Silva Anthero)

The properties of Copaiba oleoresin include healing and anti-inflammatory effects, making it an ideal candidate for treating oral lesions. In our study, we investigated the benefit of Copaiba-containing formulations on the oral cavity by examining their ability to fight inflammation and promote healing. (Ana Carolina dos Santos Menezes)

Thus, hardwickiic acid and C. pubiflora oleoresin may act to inhibit bacterial growth and be useful therapeutic agents for treating dental caries and endodontic infections. (Thaís da Silva Moraes)

Additionally, topical treatment with Copaiba oleoresin cream resulted in a reduction in inflammatory cell infiltration but not in diminished dermal thickness. A GC-MS analysis has

identified both β-caryophyllene and other sesquiterpenes as contributing to such effects, at least in part. (Gabriela Becker)

This study was designed to provide a scientific explanation for the traditional differentiation of black and white pitch oleoresins according to the non-volatile fractions. (Rayane da Cruz Albino)

For the purposes of evaluating the suitability of the mathematical model, experimental and calculated data on concentrations of red ginger oleoresin in buffer solution (CAw) were compared. Statistical analysis of controlled release models showed good agreement with experimental data, as indicated by the values of R2 = 0.76–0.86. (jayanudin)

As described in this study, the method is fast, easy, cheap, robust, and environmentally safe, offering an alternative method for routine analysis of Sudan dyes that is more efficient and reliable for monitoring against illicit food additives (Joseph Kweku Adjei).

With the addition of lemons, the volatile profile of virgin OO significantly changed, resulting in limonene, a-pinene, b-pinene, sabinene, b-myrcene, and g-terpinene. On the other hand, virgin OO volatile compounds decreased when lemon was Considering these results and the legislation for such products, addition of lemon to OO should be carried out. (Raffaele Sacchi)

- **MATERIAL AND METHODS:**
- **Material.**
- Raw material : Different type of chillies like chilli powder , red chilli , green chilli , capsicums is sourced from Guntur Mirchi yard, Guntur district, India.

- Chemical used : acetone , n-hexane , ethanol solvents are utilized in Vignan University's laboratory.

- Instrument used : Soxhlet apparatus (condenser, distillation flask, pipe, round bottom flask, heater), Ultrasonicator, UV-VIS Spectrophotometer(conc analysis)

- **Mechanisms of various methods**
    - Soxhlet extraction : Soxhlet extraction is an exhaustive extraction technique widely applied to analytes that are sufficiently thermally stable. The extraction solvent is continuously cycled though the matrix, by boiling and condensation, with the sample being collected in the hot solvent. It is the most widely used method. The extraction of naturalproducts progresses through the following stages:
      (1) the solvent penetrates into the solid matrix;
      (2) the solute dissolves in the solvents;
      (3) the solute is diffused out of the solid matrix;
      (4) the extracted solutes are collected.

    - Soaking method: The soaking extraction or static-dynamic-steps (SDS) allows the supercritical co2 to remain in contact with the raw material for the time

necessary to dissolve the target compound. The raw material is brought to the set point pressure and, when reached, the system stops the pump and isolates the extractor.

- Ultrasound assisted extraction: Ultrasound-assisted extraction (UAE) uses ultrasound energy and solvents to extract target compounds from various plant matrices. Ultrasound are the mechanical waves having frequency (>20 kHz) higher than audible frequency range of human hearing (20 Hz to 20 kHz). Sonication is also used to enhance extraction. During sonication of a solution, bubble formation and subsequent implosion result in extremely high pressure and temperature gradients, facilitating easy release of solid matrix components including cell walls and fast mass transfer.

- **Concentration analysis:**

To determine the concentrations of the samples in each ml required 2 volumetric flasks and a pipette. For each time, 1ml capsaicin sample is taken by using the pipette and then did a make up for 10ml with same solvent used for extraction in the volumetric flask and tested the photometric analysis in spectrophotometer with the reference sample as appropriate solvent.

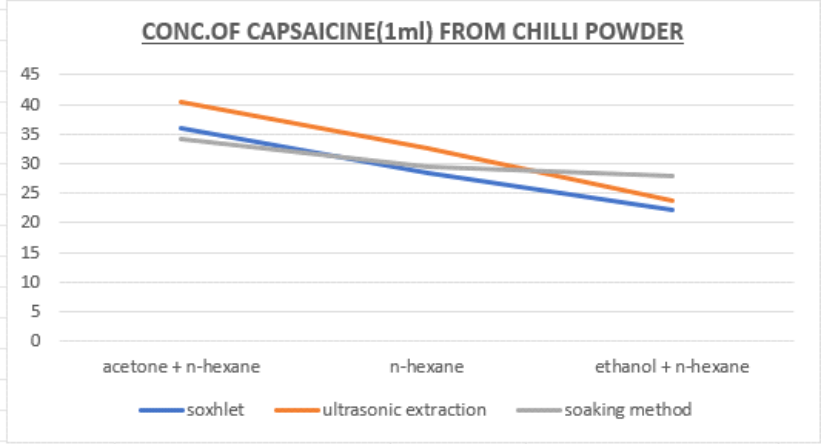
- **RESULT AND DISCUSSION**

- Concentration analysis :

For every sample , concentration is determined and compared with other results.

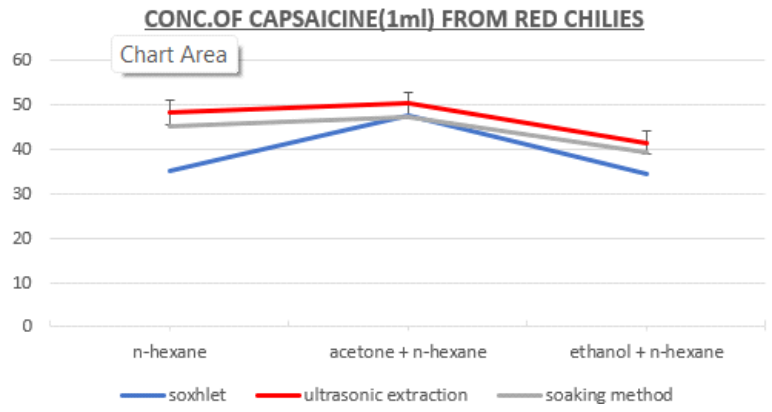
For chilli powder :

	acetone + n-hexane	n-hexane	ethanol + n-hexane
soxhlet	36	28.32	22.18
ultrasonic extraction	40.36	32.64	23.64
soaking method	34.13	29.43	27.954



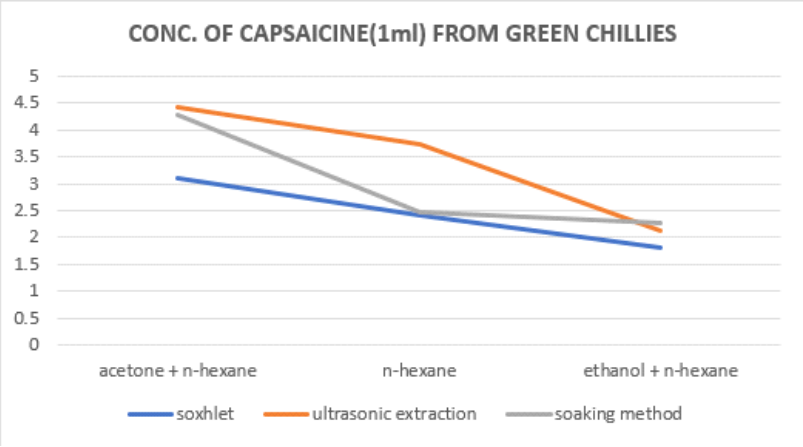
For red chilli :

	n-hexane	acetone + n-hexane	ethanol + n-hexane
soxhlet	35	47.53	34.47
ultrasound extraction	48.3	50.36	41.53
soaking method	45.3	47.32	39.2



For green chilli :

	acetone + n-hexane	n-hexane	ethanol + n-hexane
soxhlet	3.1	2.4	1.8
ultrasonic extraction	4.43	3.73	2.14
soaking method	4.286	2.47	2.27



Spectrometer is used to determine the results on concentration of each sample.

- **CONCLUSION**

By the concentration analysis , using blend of (acetone and n-hexane) gives more efficiency then followed by acetone , blend of (n-hexane and ethanol). Ultrasound extraction gives more efficienct product then compared to others , order is given as Ultrasound extraction > Soaking method > Soxhlet extraction.

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