Transforming Waste Cooking Oil into Fatty Acid Methyl Ester: A Lipase-Catalyzed Process

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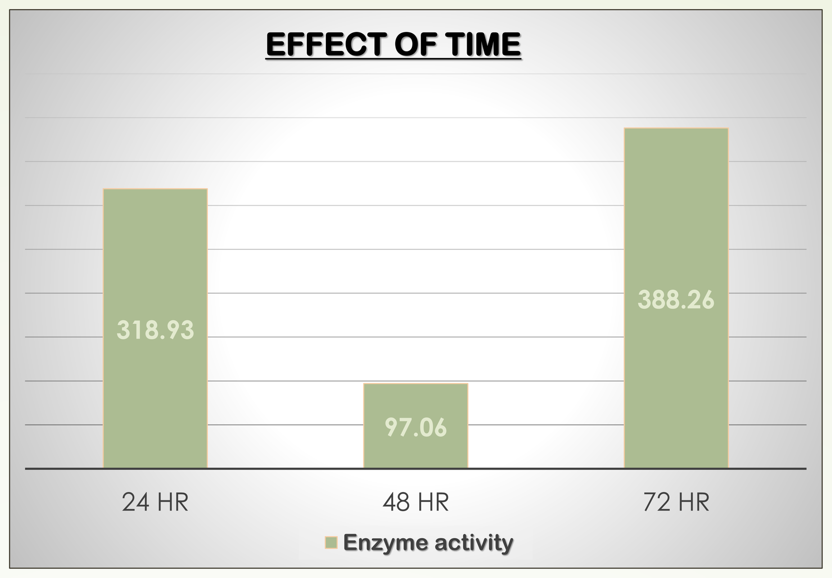
ABSTRACT

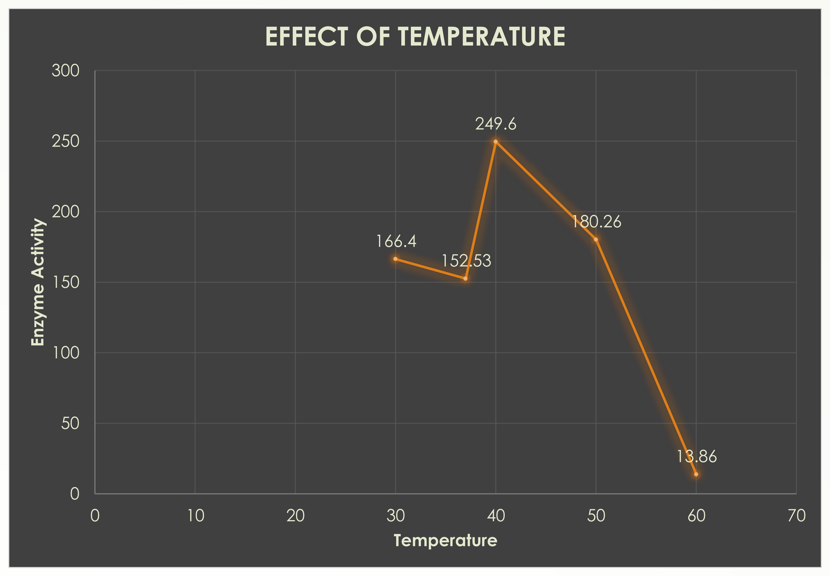
This study aimed to identify constituents in cooking oil and develop an economical method for generating fatty acids from low-cost feedstock waste. The lipase-catalyzed esterification procedure was explored as an environmentally friendly and cost-effective alternative to conventional chemical processes for biodiesel synthesis. The findings revealed that under the specified conditions, Bacillus sp. exhibited maximum lipase activity. The titrimetric analysis using olive oil as a substrate allowed for the precise determination of lipase activity.
The study found that olive oil is the best carbon source for lipase production, with 1% Ammonium Phosphate providing maximum activity. Lipase tolerates methanol and acetone well, with a low tolerance for ethanol and n-butanol.

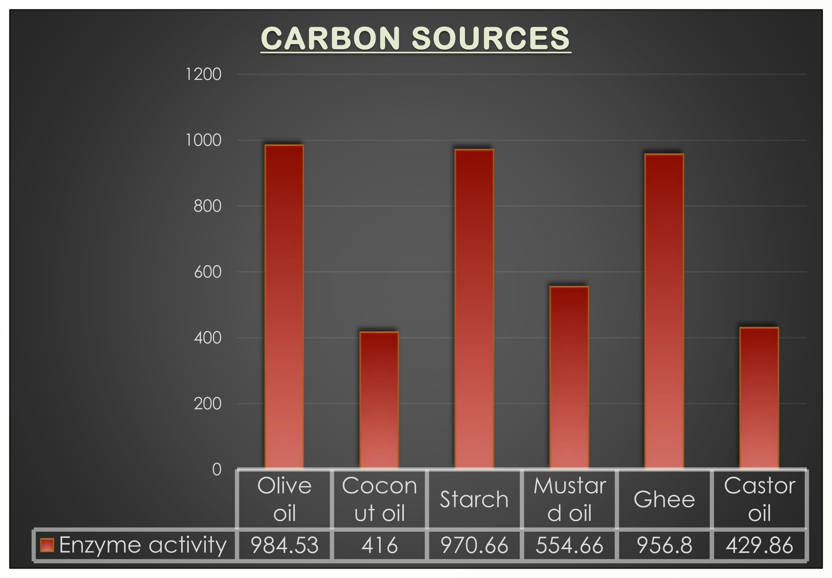
INTRODUCTION

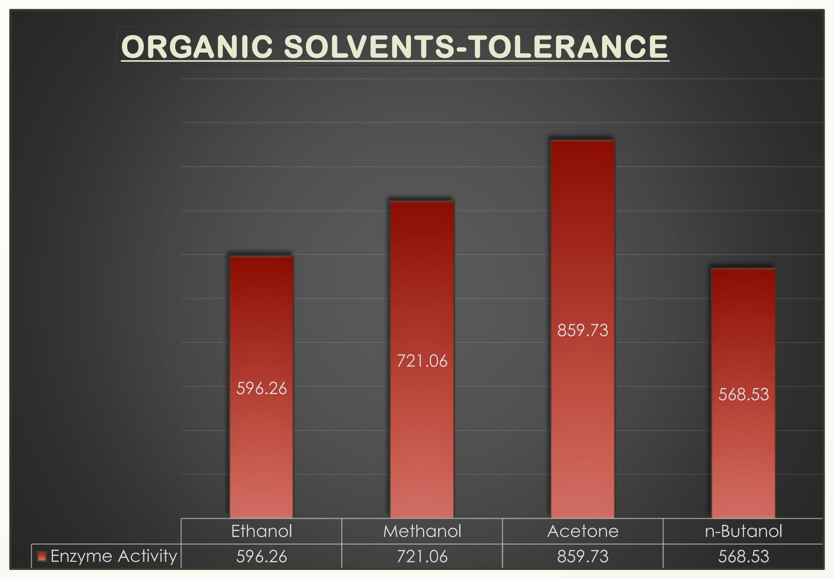
The surge in global energy demand, particularly from emerging economies, along with recent spikes in global oil prices, has propelled significant interest in biofuel research. Versatile enzymes known as lipases, obtainable from animals, vegetables, and microbiological organisms, have become focal points in various industrial processes.
This investigation delves into a lipase-catalyzed process aimed at converting waste cooking oil (WCO) into fatty acid methyl ester (FAME), a crucial element of biodiesel.
The objective is to assess the viability and efficiency of this enzymatic approach as an environmentally friendly and cost-effective alternative to conventional chemical methods. The study scrutinizes the influence of variables such as time, temperature, carbon source, nitrogen source, organic solvent, and concentration on the conversion of WCO. In the last 10 years, global biofuel production tripled. However, it still accounts for less than 3% of the world's total transportation fuel supply. Increasing demand for biofuels is contributing to rising global food and feed prices.
Biofuels are expected to be part of a diverse package of solutions to address high energy prices, alongside environmental protection efforts, increased energy efficiency, and the use of other alternative fuels.

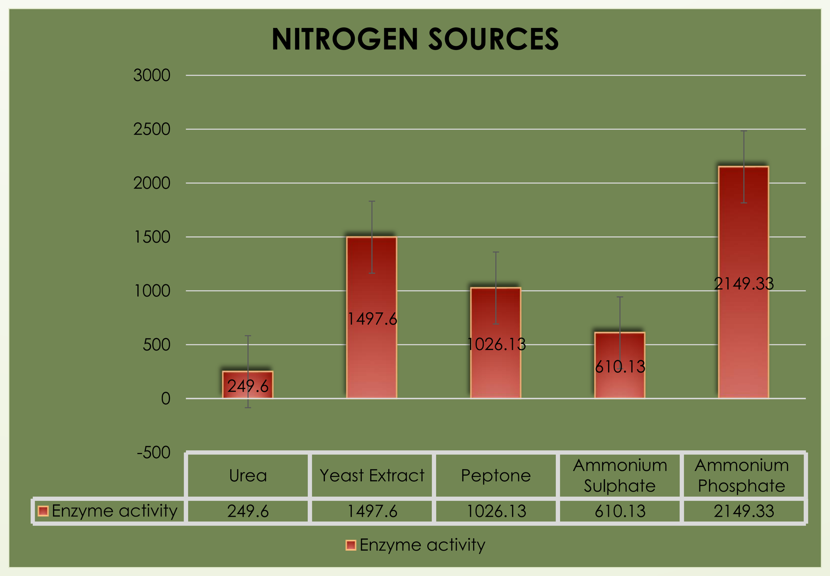
RESULTS











MATERIALS & METHODS

- The study utilized a sample obtained from lubricant-contaminated topsoil in Karachi.
- To isolate lipolytic bacteria, the sample underwent initial homogenization with distilled water and was then cultured on a nutrient agar medium at 37°C for 24 hours.
- Following this, the specimen was streaked on plates containing olive oil and incubated at 37°C for an additional day.
- The presence of clear zones around colonies on the plates served as an indicator of lipase production.
- The primary objective of this research was to explore the most favorable conditions for lipase production by Bacillus sp. through a Titrimetric process, considering diverse parameters.
- The experimental variables were investigated over a time span of 24 to 72 hours, temperatures ranging from 30 to 60°C, and various carbon and nitrogen sources, along with different organic solvents.

CONCLUSION

Research is focused on optimizing waste cooking oil biodiesel production using a lipase-catalyzed process to reduce reliance on fossil fuels and promote a greener energy sector. The process offers advantages like milder reaction conditions, reduced energy consumption, and non-edible feedstocks, meeting quality standards and regulatory requirements.

REFERENCES

1. OSHO, M., & OTOLORİN, O. M. (2023). Concomitant strain of Bacillus vallismortis BR2 and Escherichia coli Khodavandi-Alizadeh-2 for Biocatalytic Synthesis of Fatty Acid Methyl Ester from Waste Oil Feedstock. Cumhuriyet Science Journal, 44(2), 244-253. https://doi.org/10.17776/csj.1206615
2. Fatma Rmili, Bilel Hadrich, Mohamed Chamkha, Adel Sayari & Ahmed Fendri. Optimization of an organic solvent-tolerant lipase production by Staphylococcus capitis SH6. (2022) Immobilization for biodiesel production and biodegradation of waste greases. *Preparative biochemistry & biotechnology*. Volume 52, -Issue-I.
3. Harshitkumar J. Savalia and Arvindkumar Dungrechiya. (2022) Lipases: Sources of Acquisition, Ways of Production, and Recent Applications. *Pure Appl Microbiol.* ; 16(4):2592-2600.
4. Hafsa Kattatheyil, Vishnupriya Sajeela, Shahana Kabeer Saleena et al. (2022) Screening, optimization and molecular characterization of cold-active lipase producing Bacillus cereus I13 from Arctic sediments , 23 November, PREPRINT (Version 1) available at *Research Square.*
5. Marta Ostojcˇic ; Sandra Budžaki; Iva Barišic; Nghiep Nam Tran; Ivana Flanjak; Blanka Bilic Rajs;| Ivica Strelec; Volker Hessel. (2021) Production of biodiesel by Burkholderia cepacia lipase as a function of process parameters. *Biotechnol Progress.*; 37:e3109.
6. João H. C. Wancura1 & Daniela V. Rosset & Marcio A. Mazutti & Gustavo A. Ugalde & J. Vladimir de Oliveira & Marcus V. Tres & Sérgio L. Jahn. (2019) Improving the soluble lipase–catalyzed biodiesel production through a two-step hydroesterification reaction system. *Applied Microbiology and Biotechnology* 103:7805–7817.