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Low-Cost Production of Poly Hydroxy Butyrate (PHB) from Taro (Colocasia esculenta) Using Bacillus megaterium MTCC 6544: A Step Towards Sustainable Bioplastics

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Abstract

Bioplastics can provide notable environmental benefits compared with traditional plastics derived from fossil fuels, such as using renewable feedstocks, lowering carbon emissions, and being biodegradable. Polyhydroxybutyrate (PHB), a biopolymer synthesized by several microorganisms, is biocompatible and recyclable and can be used in medicine, packaging, and agriculture. This research examined PHB synthesis by Bacillus megaterium MTCC 6544 using taro (Colocasia esculenta) as an inexpensive substrate. Acid hydrolysis of taro raised its cellulose content to 84.20%. The highest PHB yield was obtained at pH 7 and 35°C. Thermogravimetric analysis showed a peak temperature of 259.8°C, and DTA indicated a melting point of 256°C with thermal decomposition at 287°C. Overall, the findings indicate that Colocasia esculenta is a suitable and low-cost feedstock for producing PHB.

1. Introduction

Global population growth and rising living standards have stimulated development across many industries. The plastics industry is one of the most efficient sectors of the global economy and continues to expand, but it is also recognized as a major environmental problem. Annual plastics production is approximately 300 million tonnes, and millions of tonnes of petroleum-based plastics enter the environment each year (Grage et al., 2017). Microbial production of PHB is important for several reasons and has many potential uses. Renewable carbon sources such as agricultural by-products, sugars, and glycerol are commonly used for microbial PHB synthesis, whereas conventional plastics are produced from non-renewable fossil resources. These conventional polymers are highly durable and degrade very slowly in the environment—on average over about 100 years—leading to hazardous contamination (Karlsson and Arneborg, 2018). Various methods for managing plastic waste, including recycling and incineration, have been proposed, but each has limitations (Dhawan and Mecaj, 2019).

Recently, research interest has grown in developing CRU using bio-derived polymeric coating materials such as starch (Versino et al., 2020), lignin (Elhassani 2019), cellulose (Pang et al., 2019), and biodegradable polyurethane (Feng et al., 2019). Polyhydroxyalkanoates (PHAs) are biodegradable polyesters synthesized by bacteria from diverse carbon sources. The use of renewable feedstocks for microbial PHB production has been widely reviewed, and agricultural and industrial wastes have been highlighted as cost-effective alternatives to synthetic media (Sathesh Prabu and Murugesan, 2009). Different carbon sources lead to different monomers, and their combinations produce varied physicochemical properties (Surendran et al., 2020). Lemoigne discovered polyhydroxybutyrate (PHB) in Bacillus megaterium in 1926 (Lemoigne 1926). Poly(3-hydroxybutyrate) (P3HB) is a well-known member of the PHA family, with physical properties comparable to those of polypropylene. PHB is synthesized and stored as granules in the cytoplasm of bacteria.

The food and pharmaceutical sectors have shown considerable interest in developing and using renewable feedstocks to produce multifunctional compounds. Efficient resource utilization is essential for creating environmentally friendly products. PHB production is effectively achieved when bacteria are

supplied with acid hydrolysate from water hyacinth, an aquatic weed, as a nutrient source (Radhika and Murugesan 2012). Similarly, coir industrial waste has been effectively used for PHB production with Ralstonia eutropha and Azotobacter beijerinickii, demonstrating the feasibility of lignocellulosic agricultural residues as substrates (Sathesh Prabu and Murugesan, 2010). Using groundnut shell hydrolysate as a feedstock for PHB biosynthesis by Azotobacter chroococcum can lower production costs and provides an effective agricultural waste management strategy; it also increases PHB production and reduces dependence on fossil-fuel-derived plastics (Nagajothi and Murugesan 2023). In addition, underutilized biomass such as Palmyra haustorium has been studied and shown to be effective as a sole carbon source for PHB production by Bacillus megaterium MTCC 6544, further supporting the viability of renewable feedstocks (Thulasiraman and Murugesan, 2022).

Taro is the common name for Colocasia esculenta, a tropical perennial plant in the Araceae family. It is widely distributed in Southeast Asia, East Africa, the Caribbean, and Southeast America (Nayik et al., 2020). The taro plant is important in agricultural and culinary traditions. Its starchy corm, native to Southeast Asia and widely cultivated in tropical climates, is the main component and is used in many cuisines (A. Gull, 2020). The underground corm is rich in carbohydrates and is a strong energy source. Phytochemical studies have identified glycosides, alkaloids, flavonoids, saponins, terpenoids, and phenols. Although taro is grown throughout India, most of the country's crop comes from West Bengal, Assam, Odisha, Kerala, Karnataka, and Maharashtra. The plant grows best in warm, humid conditions (Al-Kaf et al., 2019; Keshav et al., 2021). PHB applications include packaging films and containers, biodegradable carriers for controlled release of chemicals and drugs, surgical pins, sutures, disposable goods, wound dressings, and bone replacements (Kavitha et al., 2018).

The present study focused on producing polyhydroxybutyrate from Bacillus megaterium MTCC 6544 using natural, inexpensive Colocasia as a substrate. It also characterized the physicochemical properties and acid hydrolysis of the selected Colocasia used for PHB production, as well as the resulting PHB.

2. Material and Methods

2.1. Collection of *Colocasia esculenta*

Colocasia esculenta substrates were obtained from a local market and transported to the laboratory. The raw material was rinsed with water, cut into small pieces, and dried in a hot-air oven at 70°C for 48 h. It was then ground into a fine powder using a conventional mixer grinder and stored in an airtight plastic container until further use (Radhika and Murugesan., 2012).

2.2. Pretreatment of raw material

The *Colocasia esculenta* substrate was pretreated with 5% H_2SO_4 and autoclaved at 121°C for 30 min. The suspensions were then cooled rapidly to room temperature, and insoluble particles were removed by filtration through muslin cloth. The filtrate was over-limed with 20M NaOH and filtered again using

Whatman No. 1 filter paper. The resulting filtrate was used directly as the carbon source for fermentation (Radhika and Murugesan, 2012).

2.3. Preparation of seed culture

Bacillus megaterium MTCC 6544 grown on nutrient agar medium was inoculated into a 250 mL flask containing 100 mL of sterile culture medium with the following nutrient concentrations: peptone (10 g L^{-1}), yeast extract (5 g L^{-1}), NaCl (10 g L^{-1}), and glucose (10 g L^{-1}). The culture was incubated at 27°C for 96 h with agitation at 100 rpm.

2.4. PHB production medium

Glucose peptone broth medium (20 g L^{-1} peptone, 10 g L^{-1} dextrose, 5 g L^{-1} NaCl) was used to prepare the *Bacillus megaterium* seed culture. The inoculated media were incubated in a rotating shaker at 100 rpm for 24–48 h. Then, 5% of the respective turbid cultures was inoculated into standard minimal medium (Radhika and Murugesan 2012). *B. megaterium* was cultivated in mineral medium containing 0.79 g $MgSO_4 \cdot 7H_2O$, 2.98 g Na_2HPO_4, 1.5 g KH_2PO_4, and 15 mg $FeSO_4 \cdot 7H_2O$.

2.5. Shake flask fermentation

PHB was produced under laboratory conditions. The hydrolysate was prepared based on the quantity of reducing sugar released. The carbon source hydrolysate, minimal mineral supply, and trace elements were sterilized separately in a laboratory-scale autoclave at 121°C for 30 min at 15 lbs pressure for preparation of the fermentative medium. After steam sterilization of the raw material hydrolysate, the minimal mineral salt and trace element solutions were mixed thoroughly, and 3% inoculum was added. The culture was then incubated at room temperature in a laboratory-scale shaking incubator with a spinning speed of 100 rpm.

2.6. Extraction of PHB

PHB produced by the bacteria was collected using the dispersion method. After incubation, the culture mixtures were centrifuged at 5000 rpm for 15 min, and the culture pellets were washed with distilled water and acetone. The washed cell pellets were then treated with an equal amount of chloroform and 6% sodium hypochlorite and incubated at 37°C for 1 h. Following incubation, the solution mixture was centrifuged at 5000 rpm for 20 min. After centrifugation, three distinct layers formed: an upper layer of degraded cell materials, a middle layer of non-degraded cell materials, and a bottom chloroform layer containing PHB. The chloroform layer containing PHB molecules was subjected to non-solvent precipitation using methanol and water in a 7:3 ratio and held at 4°C for subsequent analysis.

2.7. Estimation of physicochemical properties

The physicochemical properties of plant surfaces are determined by their chemical composition. Bacteria use carbon sources as an energy source and produce PHB, while nitrogen is used to generate bacterial cell biomass (Stefana et al., 2019). *Colocasia esculenta* extract contains cellulose,

hemicellulose, phosphorus, carbohydrate, protein, lignin, and nitrogen. These were estimated through the methods listed below, and data were collected.

S.No	Content	Method of estimation	Reference
1.	Moisture	Oven drying	Jeandson et al., 2018
2.	Ash	Combustion	DI Sánchez et al., 2004
3.	Phosphorus	Spectrophotometric determination	Y Zhai 2013
4.	Nitrogen	Kjeldahl digestion method	WH Baker et al., 1992
5.	Cellulose	Medium-throughput method	Manoj Kumar & Simon 2015
6.	Hemicellulose	Acid detergent fiber (ADF) method	Goering, H D and Vansoest, P J (1975)
7.	Lignin	Acid detergent fiber (ADF) method	Goering, H D and Vansoest, P J (1975)
8.	Carbohydrate	Anthrone method	Sumanta 2021

2.8. Optimization of culture medium conditions for PHB production

The fermentation medium was supplemented with various carbon sources, including maltose, glucose, sucrose, fructose starch, and *Colocasia esculenta*, each at 1% concentration, to optimize the carbon source according to Saba et al. (2021). To optimize the nitrogen source, the medium was supplemented separately with different nitrogen sources (ammonium nitrate, ammonium sulfate, ammonium chloride, peptone, and *Colocasia esculenta*) at a concentration of 1%. Physical parameters of the growth medium are also important because they affect bacterial growth and development. pH and temperature were evaluated for favorable growth conditions. To analyze the impact of pH, various fermentation media were prepared at different pH values (5, 6, 7, 8, and 9). To analyze the impact of temperature, incubation temperatures were maintained at 25°C, 30°C, 35°C, and 45°C.

2.9. Characterization of PHB

The extracted PHB was characterized using Fourier Transform Infrared Spectroscopy (FTIR) and Thermogravimetric Analysis (TGA). For FTIR analysis, a thin film of the PHB sample was prepared, and spectra were recorded in the range of 4000–400 cm^{-1} using a (Insert Manufacturer and Model) FTIR spectrometer. Thermal stability was analyzed using a (Insert Manufacturer and Model) TGA/DTA instrument. The analysis was performed under a nitrogen atmosphere with a heating rate of (e.g., 10°C/min) from ambient temperature to (e.g., 600°C).

3. Results

3.1. Physio chemical composition of raw material (Fig. 1)

The raw material consists of lignin, cellulose and hemicellulose polymers in a predominant proportion compared to other mineral compounds. The chemical parameters of the raw material *Colocasia esculenta* are presented. In the composition of the raw material, carbohydrates are the maximum, which is 75%, and phosphorus is the minimum, which is 0. 03%. Of these elements, cellulose and hemicellulose are the most important because they contain strong carbon building blocks needed in bioplastics study.

3.2. Growth of Bacillus megaterium MTCC 6544 at different pH (5, 6, 7, 8 and 9) at various time of intervals (Fig. 2)

The effect of pH on the growth of *B.megaterium* poses impact on growth of bacteria (the optical density of the cultures was analyzed at 540 nm at various intervals [Figure.2] as well as affect the PHB production rate. Adequate pH ranges play vital role for PHB production. even slight variation on pH, metabolic processes of PHB could be impacted adversely. As per the result that was taken from different pH ranges at pH parameters (5–9), the minimum growth rate was achieved after 24 hours of incubation and the maximum growth rate was achieved after 72 hours of incubation. Compared to all pH parameters at pH 7, the growth rate was maximum. Also, minimal growth was observed at pH 9. These results conclude that the suitable pH for *B.megaterium* MTCC 6544 is pH 7.

3.3. Growth of Bacillus megaterium MTCC 6544 in different temperature at various time intervals (Fig. 3)

Figure 3 shows the effect of temperature on the growth of *B. megaterium* MTCC 6544. This effect was analyzed by estimating the optical density of the cultures at 540 nm at different time intervals. Temperature is an important factor involved in bacterial growth. Minimal growth was observed at a temperature of 45°C, and similarly maximum growth was observed at a temperature of 35°C. The optimal temperature for growth of PHB-producing bacteria is 35°C.

3.4. Growth of Bacillus megaterium MTCC 6544 in different Carbon and Nitrogen sources at various time intervals (Fig. 4, Fig. 5)

The impacts of carbon and nitrogen sources on development of *Bacillus megaterium* are shown in Fig. 4. This study showed that *Colocasia esculenta* is the leading source of carbon for the most extreme development rate. The least number of developments had a place to the fructose as carbon source (OD at 2.51). Figure 5 appeared that *Colocasia esculenta* is the foremost reasonable nitrogen source among diverse nitrogen sources with development concentration (OD at 3.10). The most reduced level of development was observed within the medium with ammonium sulfate as nitrogen source.

Figure: 6 (a) *Bacillus megaterium* MTCC 6544 culture was bought from MTCC, (b) Sub-culture of *Bacillus megaterium* MTCC 6544, (c) Centrifuged Extraction of PHB from *Bacillus megaterium* MTCC 6544 culture, (d) PHB sheet produced from *Bacillus megaterium* MTCC 6544 using *Colocasia esculenta*

3.5. FTIR SPECTRUM OF PHB SHEET

The FTIR analysis confirmed the presence of characteristic functional groups of PHB. A prominent band at 1724.63 cm^{-1} corresponds to the C = O stretching vibration of the ester carbonyl group. The bands observed at 2931.56 cm^{-1} and 2854.31 cm^{-1} are attributed to asymmetric and symmetric C-H stretching of the $–CH_2$ and $–CH_3$ groups. A peak at 1458.69 cm^{-1} corresponds to C-H bending of the CH_2 group. The band at 1279.63 cm^{-1} is indicative of C-O-C stretching vibrations, while the intense peak at 1058.21 cm^{-1} is assigned to the C-O-C bond of the ester group (Abidin, K.Y et al., 2026). The presence of these bands is consistent with the structure of poly(3-hydroxybutyrate) (Abidin, K.Y et al., 2026).

3.6. THERMAO GRAVITOMETRIC ANALYSIS

The thermal stability of the extracted PHB was evaluated by TGA and DTA. The TGA thermogram revealed a two-stage weight loss. The initial weight loss, observed below 200°C, is attributed to the evaporation of moisture and other volatile impurities. The major thermal degradation occurred in the temperature range of 250°C to 300°C, corresponding to the random chain scission of the PHB polymer. The maximum degradation temperature (Tmax) was recorded at 287°C, which is consistent with the melting temperature observed in the DTA analysis at 256°C. The DTA curve shows an endothermic peak at 256°C, corresponding to the melting temperature (Tm) of the polymer. These thermal properties are comparable to those of standard PHB and previously reported values for *B. megaterium*-derived PHB (C. S. Lumbantoruan, and F. Fitriani 2026).

4. Discussion

The use of polyhydroxybutyrate (PHB) as a substitute for non-biodegradable petroleum-based plastics costs considerably more than its fossil-fuel-derived counterparts and offers several performance benefits beyond biodegradability. To reduce the cost of PHB production, the tuber was used as the substrate for PHB generation. In this study, PHB was produced using the bacterium *B. megaterium* MTCC 6544. Youhong et al. (2013) reported that PHB is produced by *B. megaterium* R11, which was isolated in Singapore and can accumulate PHB up to 51.3% of its cell dry weight (CDW) from both glucose and xylose. PHB content and production reached 58.5% and 9.32 g/L. According to the results of several previous investigations, the chemical composition of the raw material *Colocasia esculenta* appears to be inconsistent (Buddy et al., 2009; Saranya and Shenbagarathai, 2010).

Research on low-cost cellulase has been a focus of biomass conversion over the past few decades. On-site enzyme production could be more cost-effective, and crude enzyme can be used directly for acid hydrolysis without the need for protein concentration and preservation. Although lignocellulosic materials are potential substrates for low-cost PHB production, only a few such studies have been reported so far. The highest PHB content, 73.9% (w/w), was obtained by Yu and Stahl (2008). Optimization is an efficient technique for standardizing nutrient components and the required physical conditions for superior growth and development of industrially relevant microorganisms, since the enzymatic reactions and other developmental mechanisms of microorganisms may be carried out

optimally with the help of different components of the growth environment. Medium containing carbohydrates as the primary carbon source showed impressive metabolic capacity for PHB production. A simple sugar such as glucose can be rapidly utilized by bacteria effectively, and this process increases PHB yield (Issazadeh et al., 2015).

By contrast, a complex particle such as starch cannot be easily utilized by bacteria. Thus, an increase in starch complexity leads to a decrease in PHB yield (Nehra et al., 2015). *Colocasia esculenta* consists of cellulose, carbohydrate, and nitrogen, which contribute to the highest growth rate. Therefore, the type of nitrogen source and the microorganisms used are key components for effective PHB production. In addition, precise pH control is of great importance because small changes in pH can affect the metabolism of an organism. Research on the influence of pH shows that pH 7 is the optimal pH for PHB production. Furthermore, considering the low production efficiency at pH 5 and 9, it can be concluded that pH values above and below the optimal limit can affect the enzymes involved in PHB synthesis and destroy them (Saba et al., 2021). Bharathi et al. (2016) also reported that pH 7 was optimal for PHB production by *Bacillus cereus* BB613-A. Among the five different temperature conditions, maximum PHB production was observed at 30°C and minimum at 45°C. The decrease in PHB efficiency at high temperatures may be due to low activity of the PHB polymerase enzyme (Saba et al., 2021). Hamieh et al. (2013) introduced 37°C as the optimal temperature for PHB production by *Bacillus thuringiensis* and *Bacillus subtilis*.

The results obtained in this study and other reported results confirm the findings of Thirumala et al. (2010), who stated that PHB can be produced by *Bacillus* species at temperatures of 30–38°C. The pH and temperature were standardized. The group societies of *Bacillus megaterium* MTCC 6544 were explored and optimized for the generation of microbial PHB (Silva et al., 2007; Lee, 1998).

In FT-IR analysis, the band observed at 1030.94 was attributed to the C–O bond. These band results are corroborated by the reports of Sushobhan Pradhan (2021). Pure PHB has a C–O ester bond represented by a wavenumber of 1149.21 cm^{-1}. It shows a closely related group of PHBs declared by Mathiyazhagan et al. (2020). The band found at 1419.57 cm^{-1} corresponds to the asymmetric deformation of the C–H bond in the CH_2 group. Likewise, this was confirmed by comparing the results with Jimmy et al. (2012), who obtained PHB from *B. megaterium*. Furthermore, the bands at 1647.78 cm^{-1} indicate the occurrence of O–H bonds of aliphatic compounds. This is related to the findings of Mathiyazhagan et al. (2020), who obtained PHB from *Bacillus cereus* and recorded the frequency band at 1633.71 cm^{-1}. Bands were recorded at 3292.86 cm^{-1} and 2881.16 cm^{-1}, corresponding to the C = O and C–H stretches of aliphatic carbonyl esters of most biopolymers (Mathiyazhagan et al., 2020). The band and peak profiles of PHB change due to microbial metabolism. The fingerprint region from 1000 to 400 is distinguished by the large number of infrared bands there. These can represent many different vibrations, including stretching of the C–O, C–C, and C–N single bonds, C–H bending vibrations, and some bands due to benzene rings that can be found in this region. The TGA analysis of PHB synthesized from *Colocasia esculenta* as raw material is shown in Fig. 3.6. TGA curves show two types of weight loss. The initial stage weight loss

corresponds to evaporation of physically absorbed solvents of the polymer. The degradation of the polymer commences with melting in the temperature range of 200°C to 300°C.

Recent reviews have affirmed the robust potential of *Bacillus megaterium* as a versatile platform for PHB production, capable of achieving yields up to 78.4% (w/w) and productivity of 1.73 g/L·h^{-1} in fed-batch systems (Abidin, K.Y et al., 2026). Its metabolic flexibility allows for the efficient utilization of various low-cost substrates, including lignocellulosic hydrolysates, crude glycerol, and molasses, leading to potential production cost reductions of up to 30% compared to other organisms like *Cupriavidus necator* (C. S. Lumbantoruan, and F. Fitriani 2026). The results of this study align with these findings, demonstrating the successful use of *Colocasia esculenta* hydrolysate. By optimizing the fermentation conditions, we achieved a favorable PHB yield, confirming that low-cost agricultural waste streams are viable substrates for economically and environmentally sustainable bioplastic production.

5. Conclusion

This study successfully demonstrated the production of polyhydroxybutyrate (PHB) from *Bacillus megaterium* MTCC 6544 using *Colocasia esculenta* as a low-cost substrate. Optimal production was achieved at pH 7 and 35°C, with taro serving as an effective carbon and nitrogen source. Characterization via FTIR and TGA/DTA confirmed the successful synthesis of PHB with thermal properties comparable to commercial PHB. The use of taro, an abundant agricultural crop, addresses the critical challenge of reducing PHB production costs while providing a sustainable alternative to petroleum-based plastics. Future studies should focus on scaling up production, optimizing downstream processing, and evaluating the techno-economic feasibility of this approach for industrial applications.

Declarations

Declaration of Competing Interest

The authors declare that they have no competing interests.

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Author Contribution

A.G.M. and B.A. conceived and designed the study. B.A. performed the experiments, including substrate collection, pretreatment, fermentation, PHB extraction, and optimization studies. B.A. and A.G.M. analyzed and interpreted the data. B.A. wrote the main manuscript text and prepared figures 1–8. A.G.M.

provided supervision, project administration, and critical revision of the manuscript. All authors reviewed and approved the final manuscript.

References

1. Al-Kaf AG, Al-Deen AMT, ALhaidari SAA, Al-Hadi FA (2019) Phytochemical analysis and antimicrobial activity of *Colocasia esculenta* (taro) medicinal plant leaves used in folk medicine for treatment of wounds and burns in Hufash district al Mahweet Governorate–Yemen. Univers J Pharm Res 4(2):32–35
2. Amadu AA, Qiu S, Ge S, Addico GND, Ameka GK, Yu Z, Xia W, Abbew AW, Shao D, Champagne P, Wang S (2021) A review of biopolymer (Poly-β-hydroxybutyrate) synthesis in microbes cultivated on wastewater. Sci Total Environ 756:143729
3. Aydemir D, Gardner DJ (2020) Biopolymer blends of polyhydroxybutyrate and polylactic acid reinforced with cellulose nanofibrils. Carbohydr Polym 250:116867
4. Baker WH, Thompson TL (1992) Determination of total nitrogen in plant samples by Kjeldahl. Plant Anal Ref Procedures South Region United States 368:13–16
5. Bidari R, Abdillah AA, Ponce RAB, Charles AL (2023) Characterization of biodegradable films made from taro peel (*Colocasia esculenta*) starch. Polymers 15(2):338. https://doi.org/10.3390/polym15020338
6. Chaudhary S, Kour M, Kumar R (2024) Bioplastic films from starch of *Colocasia esculenta* and its waste: A smart template for sensing applications. Int J Biol Macromol 281(Pt 1):136218. https://doi.org/10.1016/j.ijbiomac.2024.136218
7. Dhawan R, Bisht BMS, Kumar R, Kumari S, Dhawan SK (2019) Leading recycling of plastic waste into tiles with reduced flammability and improved tensile strength. Process Saf Environ Prot, 124(1)
8. Dietrich K, Dumont MJ, Orsat V, Rio D, L.F (2021) In-depth material characterization of polyhydroxybutyrate from a forest biorefinery. J Appl Polym Sci 138(46):51375
9. Elhassani CE, Essamlali Y, Aqlil M, Nzenguet AM, Ganetri I, Zahouily M (2019) Urea-impregnated HAP encapsulated by lignocellulosic biomass-extruded composites: A novel slow-release fertilizer. Environ Technol Innov 15:100403
10. Etxabide A, Kilmartin PA, Guerrero P, de la Caba K, Hooks DO, West M, Singh T (2022) Polyhydroxybutyrate (PHB) produced from red grape pomace: Effect of purification processes on structural, thermal and antioxidant properties. Int J Biol Macromol 217:449–456
11. Feng GD, Ma Y, Zhang M, Jia PY, Hu LH, Liu CG, Zhou YH (2019) Polyurethane-coated urea using fully vegetable oil-based polyols: Design, nutrient release and degradation. Prog Org Coat 133:267–275
12. Grage K, McDermott P, Rehm BH (2017) Engineering *Bacillus megaterium* for production of functional intracellular materials. Microb Cell Fact 16(1):1–12
13. Gupta RK, Guha P, Srivastav P (2024) Exploring the potential of taro (*Colocasia esculenta*) starch: Recent developments in modification, health benefits, and food industry applications. Food

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14. Hamieh A, Olama Z, Holail H (2013) Microbial production of polyhydroxybutyrate, a biodegradable plastic using agro-industrial waste products. Global Adv Res J Microbiol 2(3):54–64
15. Karlsson TM, Arneborg L, Broström G, Almroth BC, Gipperth L, Hassellöv M (2018) The unaccountability case of plastic pellet pollution. Mar Pollut Bull 129(1):52–60
16. Kavitha G, Rengasamy R, Inbakandan D (2018) Polyhydroxybutyrate production from marine source and its application. Int J Biol Macromol 111:102–108
17. Keshav A, Sharma A, Mazumdar B (2019) Phytochemical analysis and antioxidant activity of *Colocasia esculenta* (L.) leaves. Int J Chem Mol Eng 13(1):20–23
18. Lemoigne M, Monguillon P (1936) Les améliorants des beurres à base de diacétyle sont-ils des produits naturels? Le Lait 16(151):26–29
19. Mastropetros SG, Pispas K, Zagklis D, Ali SS, Kornaros M (2022) Biopolymers production from microalgae and cyanobacteria cultivated in wastewater: Recent advances. Biotechnol Adv 60:107999
20. McAdam B, Brennan Fournet M, McDonald P, Mojicevic M (2020) Production of polyhydroxybutyrate (PHB) and factors impacting its chemical and mechanical characteristics. Polymers 12(12):2908
21. Mohapatra S, Pattnaik S, Maity S, Mohapatra S, Sharma S, Akhtar J, Varma A (2020) Comparative analysis of PHAs production by *Bacillus megaterium* OUAT 016 under submerged and solid-state fermentation. Saudi J Biol Sci 27(5):1242–1250
22. Nagajothi K, Murugesan AG (2023) Polyhydroxybutyrate biosynthesis by *Azotobacter chroococcum* MTCC 3858 through groundnut shell as lignocellulosic feedstock using resource surface methodology. Sci Rep 13(1):10743. https://doi.org/10.1038/s41598-022-15672-y
23. Nagajothi K, Murugesan AG (2023) Production of biopolymer polyhydroxybutyrate from coconut coir hydrolysate: Characterization and optimization study. Environ Qual Manage 33(2):93–102. https://doi.org/10.1002/tqem.21993
24. Nayik GA, Gull A (2020) Taro (*Colocasia esculenta*). In *Antioxidants in Vegetables and Nuts - Properties and Health Benefits*, 341–353
25. Pang L, Gao Z, Feng H, Wang S, Wang Q (2019) Cellulose based materials for controlled release formulations of agrochemicals: A review of modifications and applications. J Controlled Release 316:105–115
26. Radhika D, Murugesan AG (2012) Bioproduction, statistical optimization and characterization of microbial plastic (poly 3-hydroxy butyrate) employing various hydrolysates of water hyacinth (*Eichhornia crassipes*) as sole carbon source. Bioresour Technol 121:83–92
27. Robbins CT, Van Soest PJ, Mautz WW, Moen AN (1975) Feed analyses and digestion with reference to white-tailed deer. J Wildl Manag, 67–79
28. Sánchez-Machado DI, López-Cervantes J, Lopez-Hernandez J, Paseiro-Losada P (2004) Fatty acids, total lipid, protein and ash contents of processed edible seaweeds. Food Chem 85(3):439–444

29. Saratale RG, Cho SK, Saratale GD, Kadam AA, Ghodake GS, Kumar M, Bharagava RN, Kumar G, Kim DS, Mulla SI, Shin HS (2021) A comprehensive overview and recent advances on polyhydroxyalkanoates (PHA) production using various organic waste streams. Bioresour Technol 325:124685
30. Sathesh Prabu C, Murugesan AG (2007) Microbial production of PHB (Bioplastic) from industrial and agricultural wastes. *Proceedings of the National Seminar on Biopolymer: Source, Structure and Applications in Biotechnology*, pp. 3–7
31. Sathesh Prabu C, Murugesan AG (2009) Microbial Production of Biodegradable Plastics from Various Renewable Sources- A Review. J Mod Sci 1(1):28–36
32. Sathesh Prabu C, Murugesan AG (2010) Effective utilization and management of coir industrial waste for the production and extraction of poly- β- hydroxybutyrate using the bacteria, Ralstonia eutropha and Azotobacter beijerinickii. Int J Environ Res 4(3):519–524
33. Shetty A, Afroz A, Ali L, Siddiquea BN, Sumanta M, Billah B (2021) Health-related quality of life among people with type 2 diabetes mellitus–A multicentre study in Bangladesh. Diabetes Metabolic Syndrome: Clin Res Reviews 15(5):102255
34. Surendran A, Lakshmanan M, Chee JY, Sulaiman AM, Thuoc DV, Sudesh K (2020) Can polyhydroxyalkanoates be produced efficiently from waste plant and animal oils? Front Bioeng Biotechnol 8:169
35. Thulasiraman N, Murugesan AG (2022) Potential Utilization of the Underutilized Food Stuff Palmyra Haustorium as The Sole Carbon Source for the Synthesis of Biopolymer Poly Hydroxy Butyurate (PHB) using Bacillus megaterium MTCC 6544. International Journal of Food and Nutritional Sciences. Volume 11, Issue – 12 (2022)
36. Versino F, Urriza M, Garcia MA (2020) Cassava-based biocomposites as fertilizer controlled-release systems for plant growth improvement. Ind Crops Prod 144:112062
37. Woolley JP, Kirby E, Leslie J, Jeanson F, Cabili MN, Rushton G, Hazard JG, Ladas V, Veal CD, Gibson SJ, Tassé AM (2018) Responsible sharing of biomedical data and biospecimens via the Automatable Discovery and Access Matrix (ADA-M). NPJ Genomic Med 3(1):17
38. Zhai Y, Petrowsky H, Hong JC, Busuttil RW, Kupiec-Weglinski JW (2013) Ischaemia–reperfusion injury in liver transplantation from bench to bedside. Nat Reviews Gastroenterol Hepatol 10(2):79–89

Figures

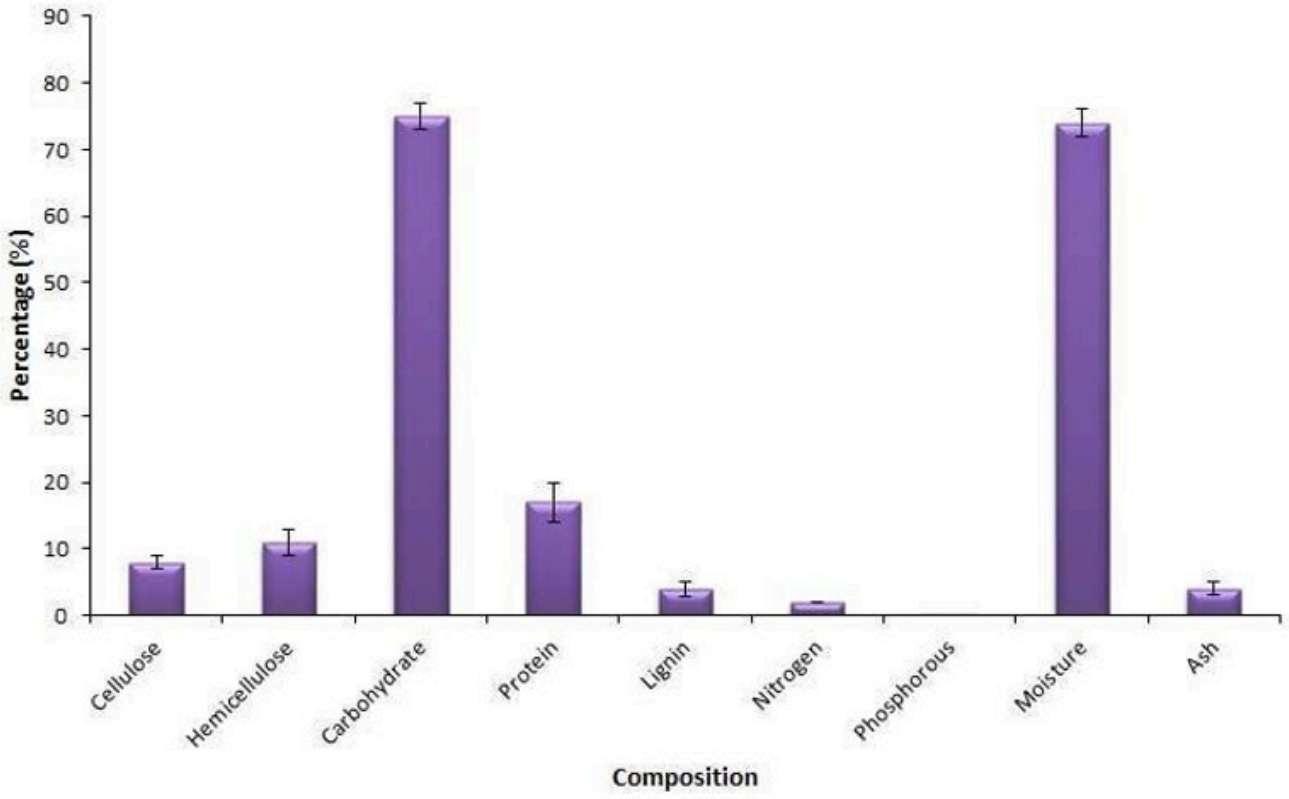


Figure 1

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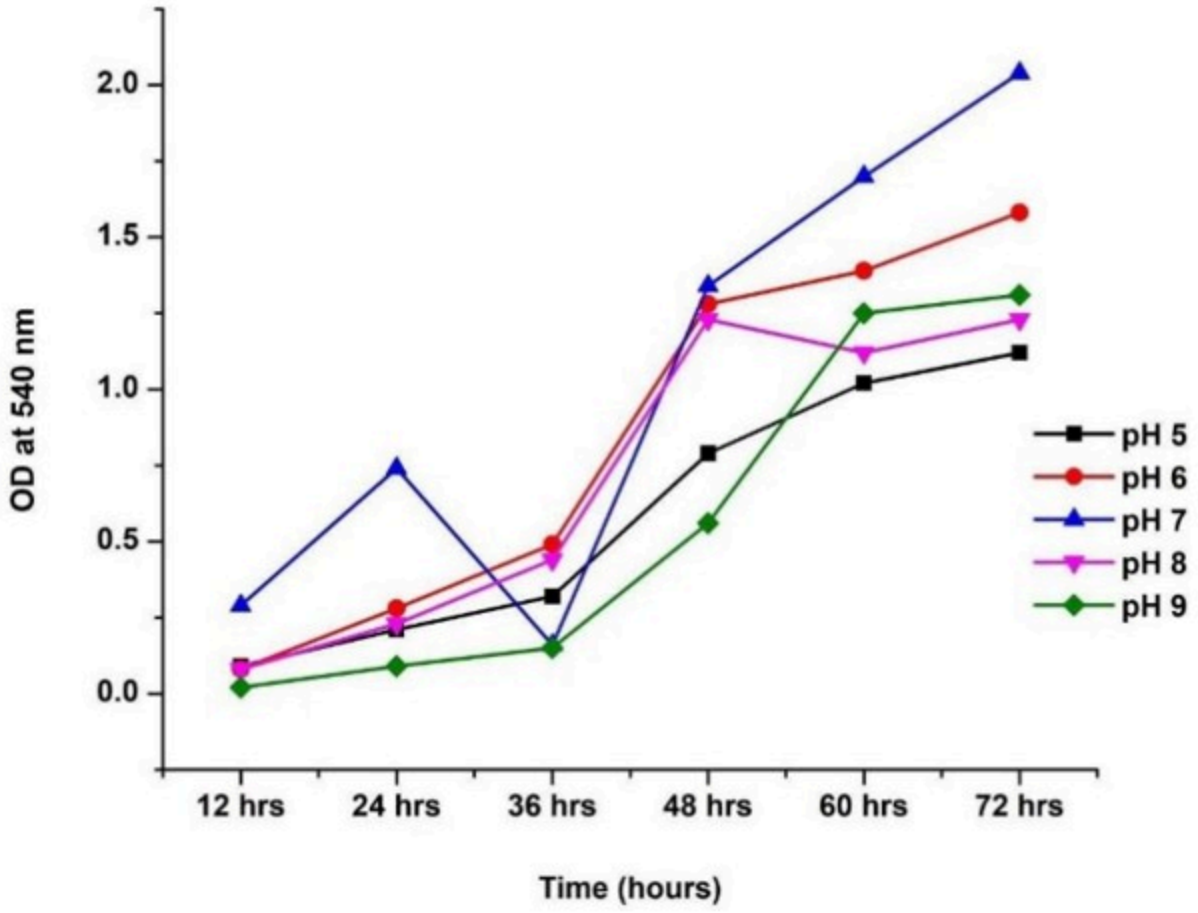


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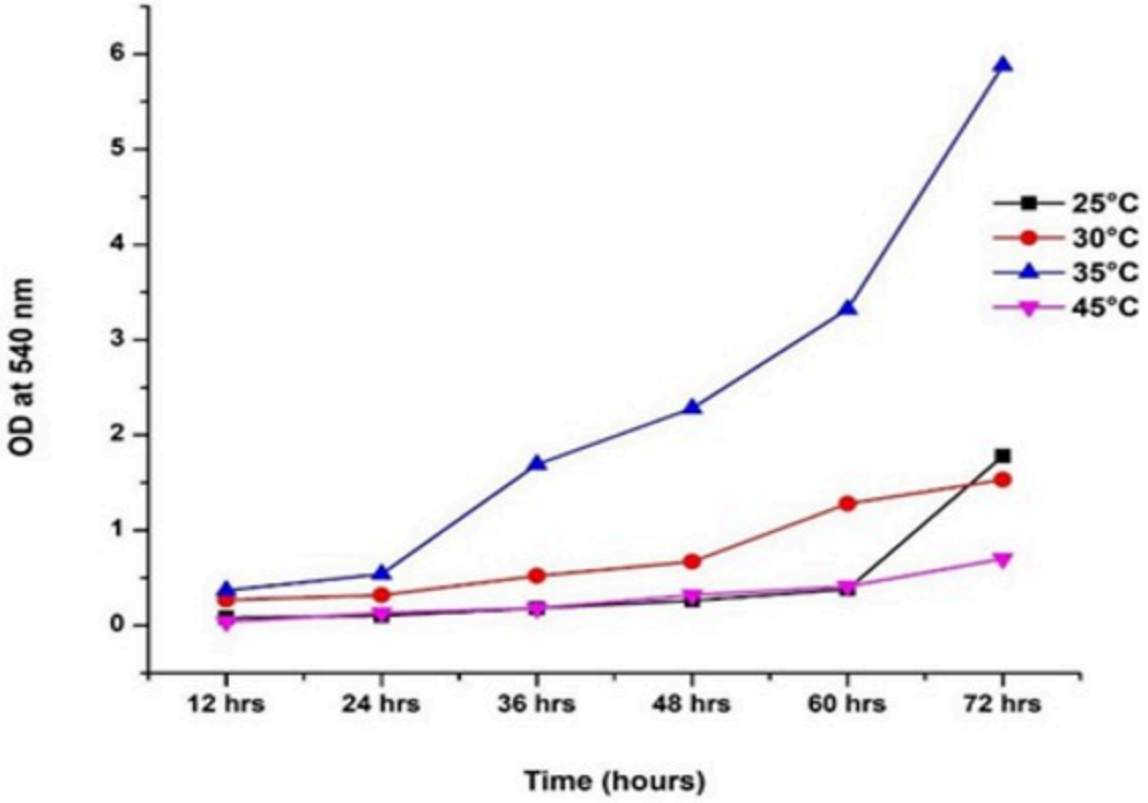


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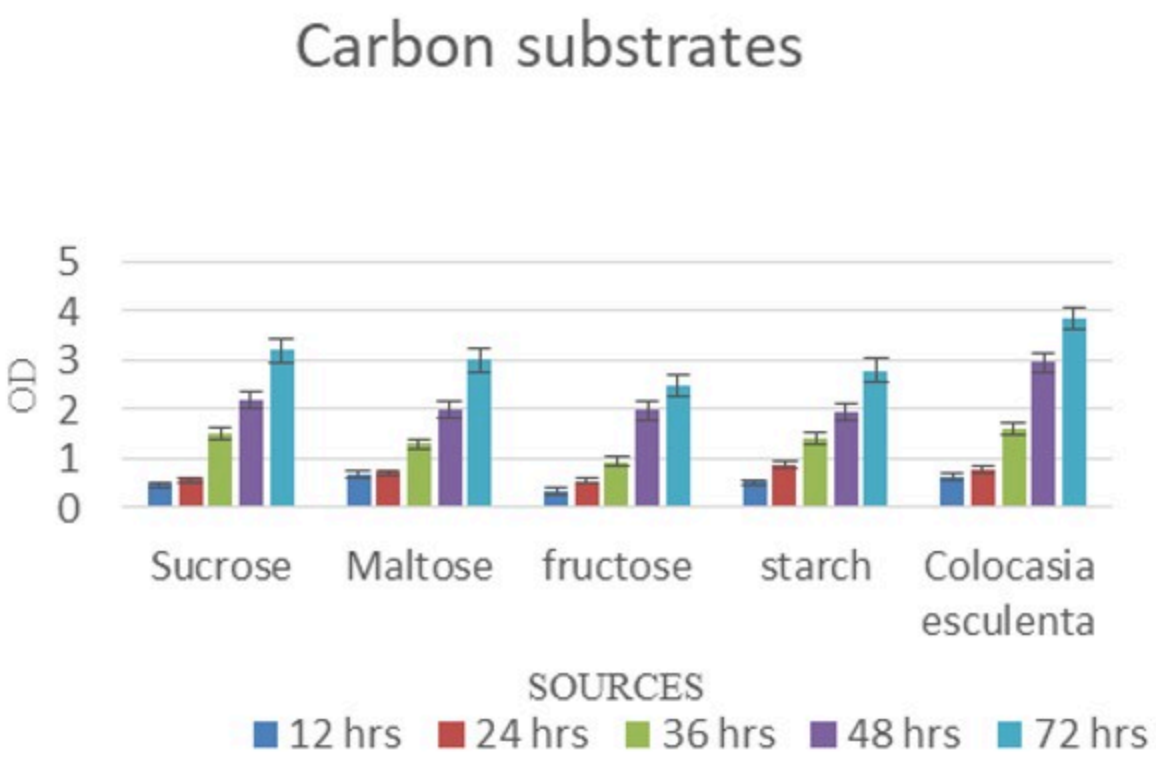


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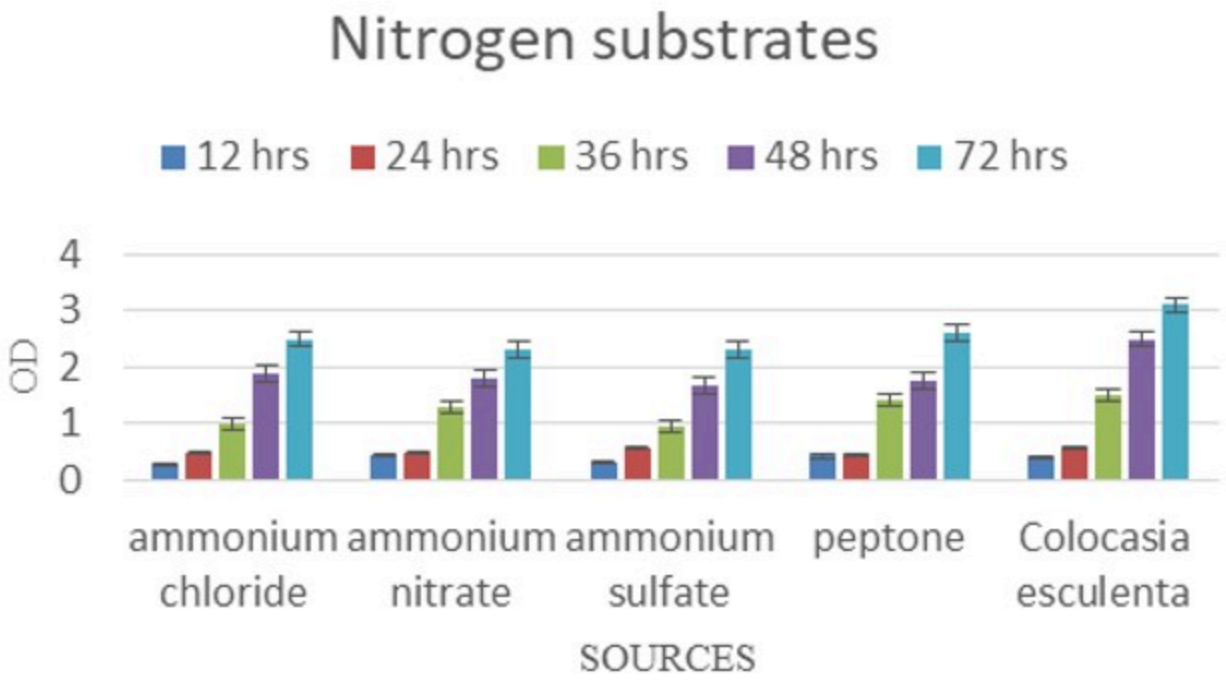


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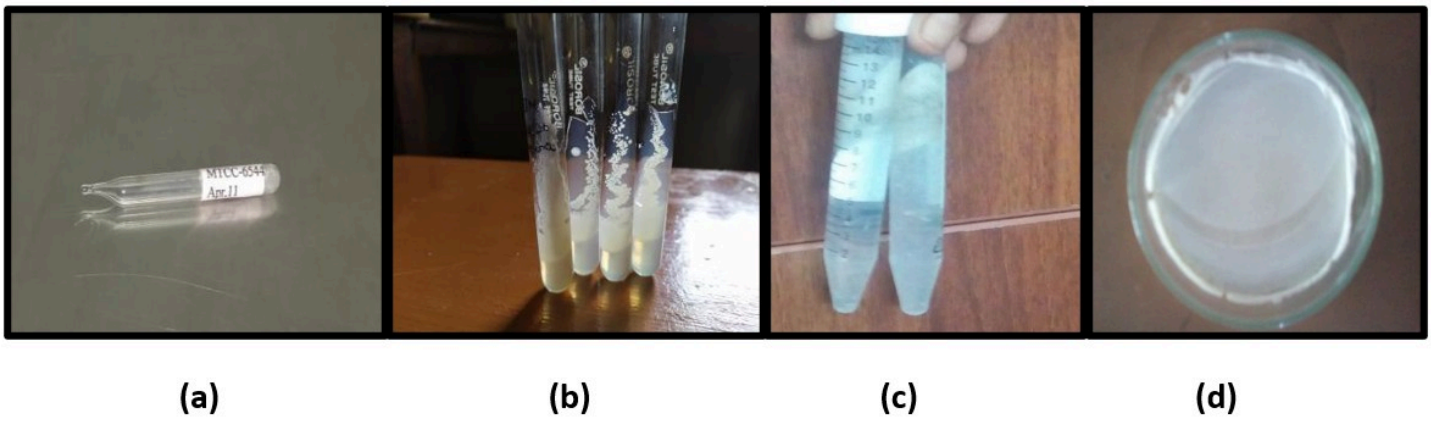


Figure 6

PHB sheet produced from using *Colocasia esculenta Bacillus megaterium* MTCC 6544 culture

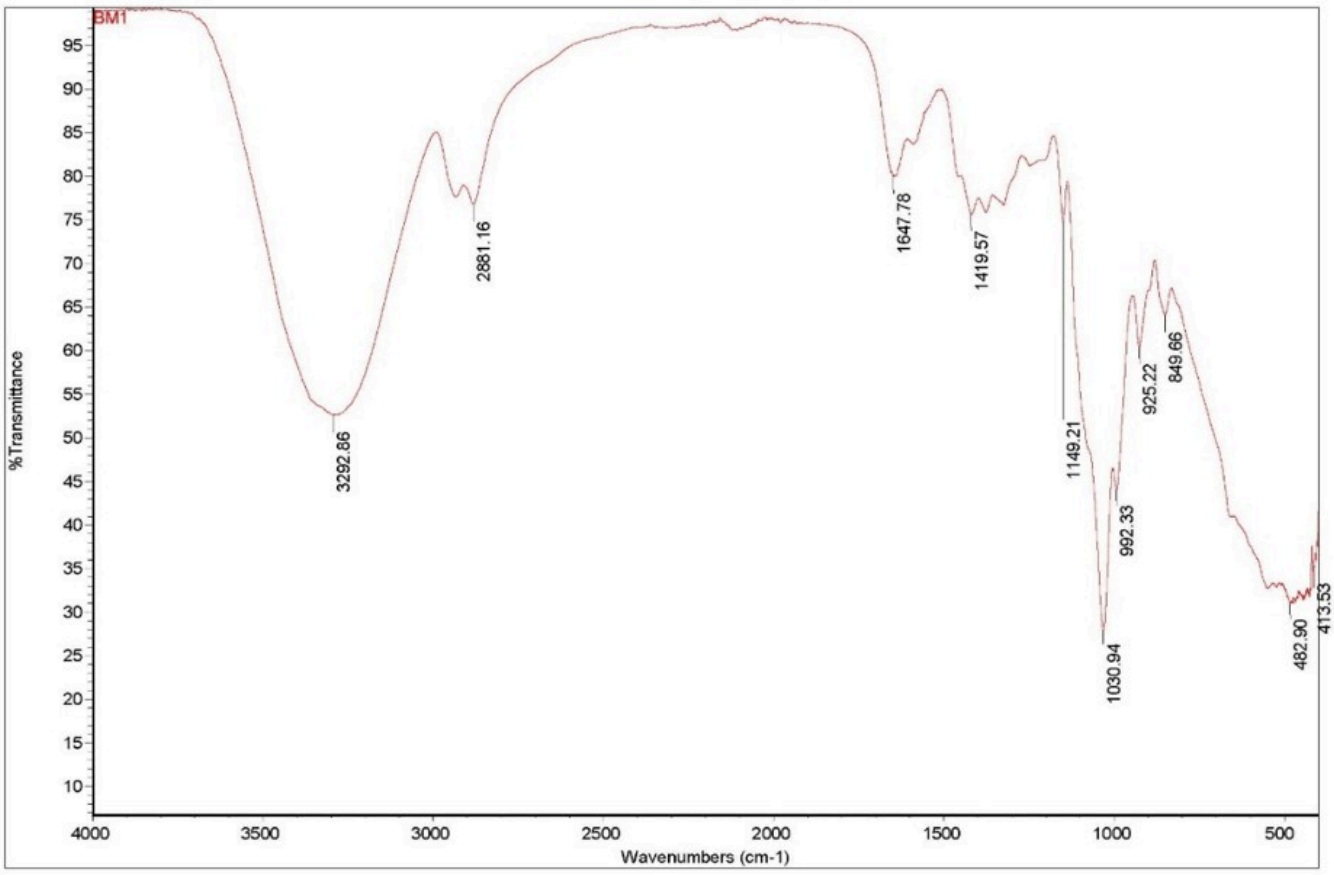


Figure 7

FTIR spectrum of PHB produced from *Bacillus megaterium* MTCC 6544 using *Colocasia esculenta*.

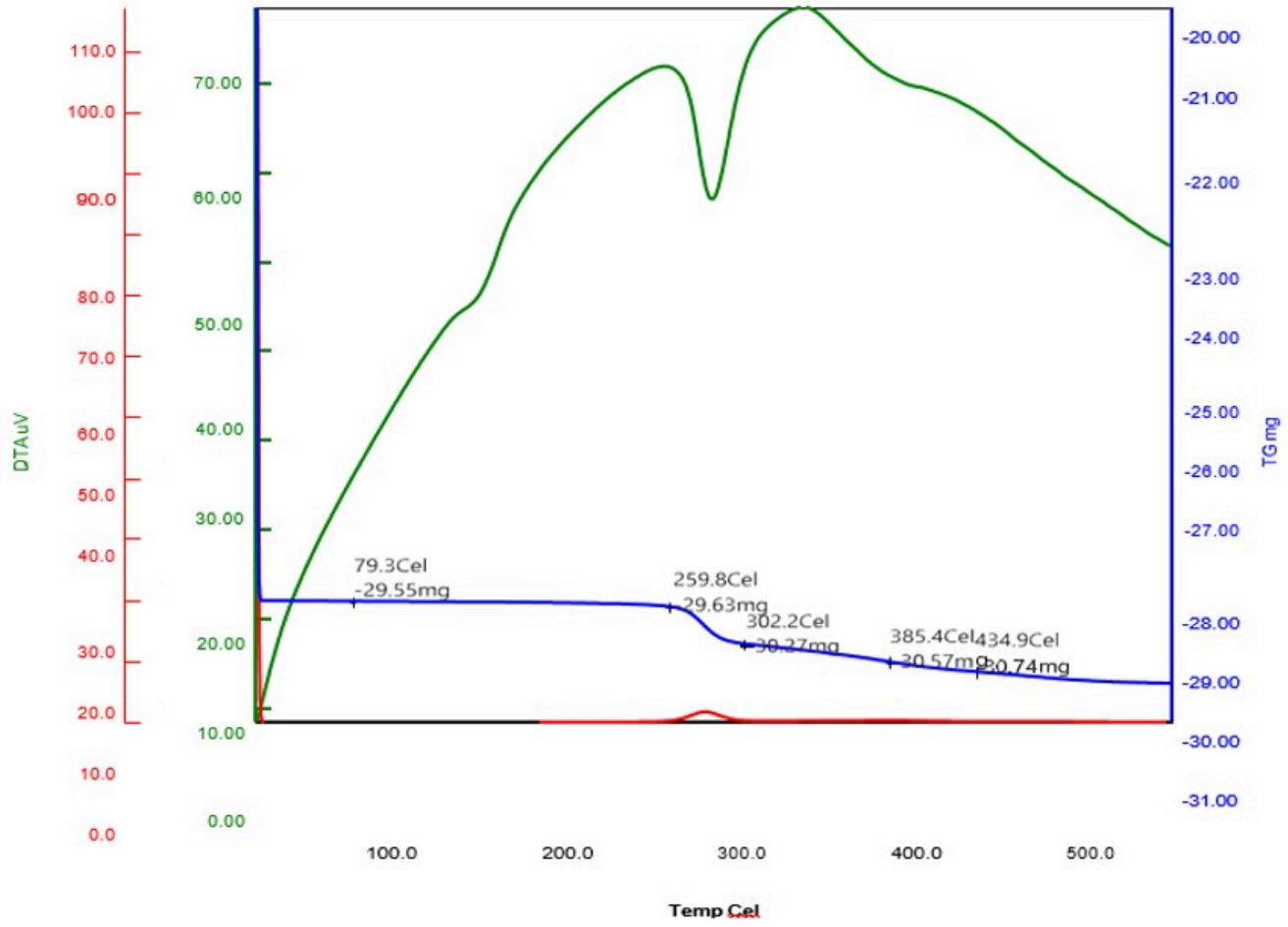


Figure 8

TGA and DTA curves of PHB produced from *Bacillus megaterium* MTCC 6544 using *Colocasia esculenta*.

Supplementary Files

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- GraphicalAbstract.jpg