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ORIGINAL PAPER

Challenges of exopolysaccharides production from polystyrene degradation by bacterium CHB 1.5 strain

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Abstract Polystyrene (PS), a substance that constitutes a significant portion of plastic waste, has resulted in environmental pollution and adverse health effects. Biodegradation and chemical transformation of PS are limited. However, biodegradation is one alternative way to reduce plastic pollution. This research aims to select plastic-degrading bacteria and produce exopolysaccharides (EPS) from plastic waste. Among the marine plastic waste at Chala tat Beach (Songkhla, Thailand), 35 rod-shaped and Gram-positive bacteria were found. The selected strains that exhibited the highest optical density (OD) at 600 nm were CHB1.5, CHD2.2, and CHC3.2. The efficiency of EPS production was tested and showed that CHB 1.5 could produce the maximum amount of EPS (13.47 ± 0.10 g/L) with a significant difference. After four weeks of plastic breakdown, CHB 1.5 had the highest total count (4.03 ± 0.02 Log CFU/mL), followed by CHD2.2 and CHC3.2 (3.99 ± 0.12 and 3.96 ± 0.02 Log CFU/mL, respectively). CHB 1.5 was also examined to use PS foam as a carbon source in modified Mineral Salt Medium for EPS production, with an EPS yield of 1.36 ± 0.08 g/L in week 4. The presence of amides I, polysaccharides, benzene rings, and hydroxyl groups (O–H) was detected by Fourier transform infrared spectroscopy. The Scanning Electron Microscope images confirmed the adherence of the CHB1.5 strain and EPS formation on the plastic sheet. In conclusion, the strain CHB1.5 showed promising potential for degrading PS plastic and producing EPS. Its qualities could be utilized in the future, as well as contribute to the reduction of plastic pollution in the environment in an eco-friendly way.

Keywords Plastic waste · Polystyrene · Biodegradation · Exopolysaccharides · Gram-positive

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Introduction

The accumulation of plastic waste resulting from the global plastic production boom has presented a serious environmental concern. Conventional plastics contribute to pollution, damage ecosystems, and affect human health because they are mostly made of non-renewable materials and are capable of remaining in the environment for hundreds of years. Particularly, marine plastic pollution negatively affects the

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environment in a number of ways, such as entangling, starving, and suffocating creatures, drifting microbes, and even the loss of habitat (Gregory 2009). The estimate for the amount of plastic in the oceans was between 75 and 199 million metric tons (UNEP 2021). Plastics are mostly made from long-chain polymers derived from fossil fuels. Plastics include nylon, polystyrene (PS), polyethylene terephthalate (PET), polyvinyl chloride (PVC), polycarbonate (PC), polyethylene (PE), and polypropylene (PP), among other materials used in daily life (Fan et al. 2021). PVC, PE, PP, PS, and other plastics are made from C–C backbone polymers, which account for 77% of the global market. However, heteroatomic polymers, which are mostly PU and PET (C–O backbone polymers), contribute to around 18% of the plastics market (Ali et al. 2021; Dimassi et al. 2022). In particular, PS is a thermoplastic polymer characterized by its significant resistance to biodegradation. This is the reason why this polymer type fails to undergo the rapid biodegradation that is frequently seen with PP and PE residues (Mor and Sivan 2008; Dimassi et al. 2022). Plastic degradation is the result of a plastic polymer changing physically or chemically due to environmental variables including heat, light, humidity, biological activity, or chemical conditions (Fibriarti et al. 2021).

Microbes play an important role in the biodegradation of plastic because plastic can dissolve entirely and does not produce secondary pollutants. In order to access certain components required for their growth, bacteria can break down complicated compounds into simpler forms. Hence, microbial biodegradation is a safe and environmentally beneficial solution to the problem of plastic accumulation in nature. It is known that the most significant species involved in the breakdown process are bacteria, and a variety of bacteria can break down a wide range of plastic varieties. Several studies reported that the *Bacillus* genera posed the capability to break down a variety of plastic types. Low-density polyethylene (LDPE) was broken down by two bacterial isolates, *Bacillus amyloliquefaciens* (BSM-1) and *Bacillus amyloliquefaciens* (BSM-2) (Das and Kumar 2015). About 10% of plastic bags was degraded by *Bacillus* PL-01 (Shovitri et al. 2017). High-density polyethylene (HDPE), a synthetic polymer, was biologically degraded by *Bacillus safensis* CGK192 (Accession No. OM658336) and *Bacillus australimaris* CGK221 (Accession No. OM658338) (Sharma et al. 2024). The breakdown of microplastics through biodegradation, particularly polyvinyl chloride (PVC), employed the *Bacillus albus* bacterial strain to produce derivatives (Naveed et al. 2024).

EPS are unique biopolymers with a wide range of applications that are made by bacteria. In particular, bacterial EPS are remarkable for enhancing the rheological and sensory qualities of food items, positively impacting texture and organoleptic properties (Bhowmik et al. 2025). Pharmaceutical and biomedical applications are also highly interested in EPS because they serve as conjugates for intelligent drug delivery and have a variety of bioactivities, including antioxidant, antiviral, immunomodulatory, and anti-inflammatory properties (Wu et al. 2021; Abdalla et al. 2021; Bhowmik et al. 2025). Because of these, it can be used in a variety of industries such as food, medicine, and pharmaceuticals. Bacterial EPS can be produced extracellularly by enzymes found in the cell wall, or it can form intracellularly and be released. The studies revealed that EPS was derived from *Bacillus* genera. The ability of EPS made by the marine bacteria *Bacillus halotolerans* to inhibit the growth of clinical strains of *Serratia marcescens* and *Pseudomonas aeruginosa* (Ravindran et al. 2024). Using 16S rRNA, an exopolysaccharide-producing soil bacterium was identified as *Bacillus* sp. EPS003 (Marimuthu et al. 2023). For the capacity to create biofilms, 22 strains of *Bacillus cereus* were used and produced biofilms in EPS form (Hsueh et al. 2008). The process of biofilm formation began with the enrichment of the surface by organic molecules, which was followed by the chemical breakdown of polymers to promote bacterial cell adhesion and growth (Chen et al. 2020). Therefore, this research aims to isolate bacteria from plastic waste in order to determine the strain capable of efficiently breaking down biodegradable polymers. The study was also investigated to challenge the EPS production from PS plastic by selected strain. This study highlighted how important it was to use bacteria to develop environmentally beneficial ways of managing plastic wastes.

Method and material

Isolation and screening of plastic-digesting bacteria

Marine plastic waste samples were collected from Chala tat Beach, Songkhla province, Thailand (7° 11′ 59.6″ N, 100° 36′ 19.8″ E), including plastic boxes,

PVC foam, and plastic bag wastes. To prepare the serial dilutions, 10 g of marine plastic waste and 90 mL of sterile 0.85% NaCl were mixed and diluted until 10^{-3}.Then, they were soaked in water bath at 80 °C for 10 min. The dilutions were spread in nutrient agar (NA) and incubated at 37 °C for 24–48 h. After that, the bacteria were purified and characterized using a Gram stain. The selected strains were screened by cultivating in nutrient broth (NB) at 100 rpm, 37 °C for 24 h. Then, three strains with an optical density (OD) 600 nm value higher than 2.5 using a spectrophotometer (Shimadzu-Japan) were selected and used for the next experiments.

EPS production by selected strains

Three selected strains were cultivated in 50 ml of NB medium and shaken at 100 rpm, 37 °C for 24 h. In 50 ml of NB, 10% of the inoculum size was added (Habib et al. 2020; Hossain et al. 2024) with $OD_{600} = 0.5$, and the prior conditions were maintained. Then the cell culture was centrifuged at 11,000 rpm for 10 min (Rotina 420R, Hettich Zentrifugen, Germany). After collecting the supernatant and adding cold acetone (1:2 v/v, supernatant: cold acetone), the mixture was kept overnight at 4 °C. The EPS pellets were collected after centrifugation at 12,000 rpm for 15 min. They were washed three times with distilled water. The dry weight was then determined by drying EPS at 60 °C (Razack et al. 2013).

Plastic digestion by selected strains

All 10 pieces of PS plastic (1 cm × 1 cm) were sterilized by soaking them in 70% alcohol for 30 min and air-dried in the laminar airflow chamber. To investigate the biodegradation under the limited conditions, PS plastics were placed on sterilized sand in a jar that was about 2 cm high. Then the PS plastic in the bottle was treated with 10% of the inoculum size ($OD_{600} = 0.5$) of each selected bacterium that had been growing in NB medium for 24 h. They were covered again with sterilized sand until the surface was 2 cm thick (modified from Shovitri et al. 2017) (Fig. 1) and incubated for 4 weeks. The parameters, such as the weight of plastic and the total number of bacteria, were measured every week. After washing PS plastic sheets from the sand in distilled water and drying them overnight at 60 °C, the percentage weight loss was calculated using the following formula (Singh et al. 2024):

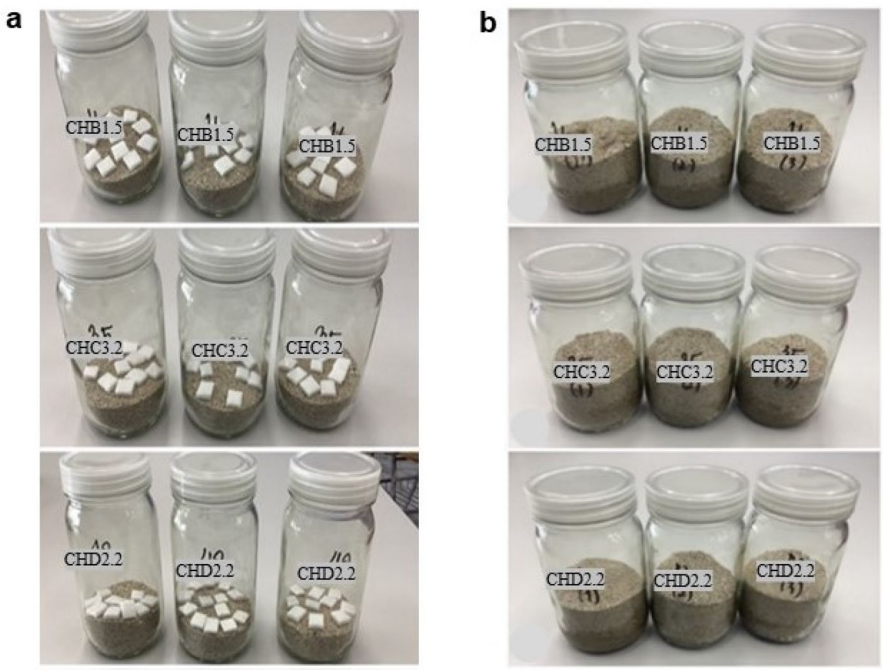

Fig. 1 PS plastic digestion test in the sterilized sand by selected strains; **a** Ps plastics were placed on the sterilized sand before adding selected bacteria and **b** after adding selected bacteria, the sterilized sand was covered again on the PS plastic

$$\text{Weight loss (\%)} = \left[\frac{\text{Initial Weight} - \text{Final weight}}{\text{Initial Weight}}\right] \times 100$$

EPS production from the PS foam food packaging treated by CHB 1.5 and its characteristic by FTIR analysis

A modified Mineral Salt Medium (modified from Sekar et al. 2011) was used to cultivate CHB 1.5. The composition included 1.73 g K_2HPO_4, 0.68 g KH_2PO_4, 0.1 g $MgSO_4.7H_2O$, 4 g NaCl, 0.03 g $FeSO_4.7H_2O$, 1 g NH_4NO_3, and 0.02 g $CaCl_2.2H_2O$. This medium was supplemented with 0.75 g of PS plastic (10 pieces, 1 cm × 1 cm) as a carbon source. The 10% inoculum size (OD_{600} = 0.5) of CHB 1.5 was added to 100 mL of modified MSM medium. After that, they were shaken at 100 rpm and incubated at 37 °C for 4 weeks. The parameters were analyzed weekly, such as the amount of CHB 1.5 and EPS production, while plastic weight loss was evaluated at week four. Then, using a Fourier Transform Infrared Spectrometer (FTIR, INVENIO-S, Bruker, Germany), the EPS characteristics were assessed in the 4000–400 cm^{-1} range.

Scanning electron microscope (SEM) image for plastic biodegradation by CHB 1.5 strain

Based on the results, the CHB 1.5 isolate exhibited high plastic digestion efficiency and EPS production. The SEM image of CHB 1.5 isolation-digested plastic was evaluated for observation of bacterial adhesion in the fourth week using Scanning Electron Microscope (SU3900, Hitachi, Japan).

Statistical analysis

Three biological replicates were used for each experiment in this study, and SPSS Statistics version 16.0 was used for analysis. A one-way analysis of variance was used to examine the parameters: bacterial count, plastics weight, and EPS production.

Results and discussions

Isolation and selection of plastic-digesting bacteria

The purpose of this experiment was to evaluate the bacteria, particularly those from marine environments, that degrade plastic wastes in the environment. Thirty-five isolates of Gram-positive, rod-shaped were discovered (data not shown). Then, the bacteria growth was evaluated by measuring the OD at 600 nm, and the top 3 bacteria were selected. The results found that all isolates had an OD value at 600 nm in the range of 0.49–4.60. The selected strains were CHC3.2, CHD2.2, and CHB1.5, with respective OD values at 600 nm of 4.60 ± 0.36, 3.20 ± 0.170, and 2.77 ± 0.15 (data not shown). According to Gupta et al. (2010) revealed that Gram-negative and Gram-positive bacteria were isolated from PE plastic waste samples for 51 and 35 isolates, respectively. The majority of bacteria were *Pseudomonas, Xanthomonas, Flavobacterium, Agrobacterium,* and *Bacillus* species. Also, Mohammed et al. (2019) reported the removal of polyhydroxyalkanoate (PHA) from *Bacillus* spp. BPPI-14 and BPPI-19 that were isolated from landfills containing plastic waste.

Extraction of EPS from selected bacteria

The synthesis of EPS from selected bacteria was investigated in order to find additional qualities that may increase application. EPS extraction from selected bacteria (CHB1.5, CHC3.2, and CHD2.2), which were cultivated in NB medium and shaken at 100 rpm for 24 h. They were centrifuged to precipitate EPS in acetone, then dried to determine dry weight. The results show that CHB 1.5 gave the highest EPS production, generating 13.47 ± 0.10 g/L of EPS with a significant difference, followed by CHD2.2 and CHC3.2 (8.44 ± 0.91 and 4.89 ± 0.91 g/L, respectively) (Table 1). Since a number of factors, including genetic factors, influence the generation of EPS (Çam and Brinkmeyer 2020), CHB 1.5 produced more EPS than other strains. This study exhibited that the EPS production was higher than the report by Ravindran et al. (2024), who revealed the ability of EPS from marine bacteria *Bacillus* to inhibit bacterial growth. Several carbon sources were investigated in order to maximize the creation of EPS, and it was shown that peptone, glucose, and calcium

Table 1 EPS yields generated by the selected strains on NB medium after a cultivation period of 24 h

Isolate	EPS (g/L)
CHB 1.5	13.47 ± 0.10^{a}
CHC 3.2	4.89 ± 0.91^{c}
CHD 2.2	8.44 ± 0.91^{b}

Different lowercase letters indicate significant differences ($p < 0.05$)

chloride were significant factors leading to increase production. The optimized medium (glucose 30 g/L, peptone 7.5 g/L, and calcium chloride 2.5 g/L) gave a greater EPS production rate of 0.61 g/L than the unoptimized medium, which produced 0.56 g/L. Luang-In et al. (2018) showed a study that characterized and determined the biological activity of EPS derived from *Bacillus tequilensis* PS21. The EPS production at 52 h was 184.6 mg/L for wet weight and 112.1 mg/L for dry weight. The EPS yield improved by 1.5 mg/L/h.

Plastic degradation test by selected strains

To examine the efficient decomposition of plastic, sterile PS foam food packaging was placed on sterile sand, and 10% inoculum of each isolate (CHB1.5, CHC3.2, and CHD2.2) was inoculated. They were then covered with sterile sand and incubated for four weeks. These results showed that the selected isolates (CHB1.5, CHC3.2, and CHD2.2) were found to be 4.35 ± 0.05, 4.98 ± 0.08, and 4.97 ± 0.00 Log CFU/mL, respectively, at week 1. Then, they were decreased and found to be 2.81 ± 0.04, 3.72 ± 0.11, and 3.38 ± 0.12 Log CFU/mL, respectively, for week 2. During weeks 3–4, bacterial counts were increased in all three isolates, reaching 3.81 ± 0.21–4.03 ± 0.02, 3.83 ± 0.04–3.99 ± 0.12, and 3.72 ± 0.08–3.96 ± 0.02 Log CFU/mL, respectively. However, at the end of the experiment, the total count number of all selected strains was not different significantly ($p < 0.5$) (Fig. 2). While the plastic weight was decreased from its initial weight (6.00 mg) in week 4. Plastics were digested by CHB1.5, CHD2.2, and CHC3.2, with plastic weights of 5.60 ± 00.00, 5.15 ± 0.17, and 5.10 ± 0.12 mg, respectively. When compared to other selected strains, the plastic weight degraded by CHB1.5 showed a significant difference ($p < 0.5$) (Fig. 3). The percentages of weight loss were 6.67%, 14.17%, and 15.00%, respectively. The results showed that the selected strains could utilize PS foam food packaging as a nutrient for growth, as the CHB 1.5 and CHC 3.2 strains were obtained from PVC foam waste and the CHD 2.2 strain from plastic bag waste. Comparing this study to Yao et al. (2022), who reported the bacterial breakdown of low-density polyethylene (LDPE), they discovered that plastics had a greater proportion of weight loss. LDPE plastics were broken down by *B. subtilis* ATCC6051 and *B. licheniformis* ATCC14580 after 30 days. Weight reductions with LDPE were discovered of 2.83% and 3.49%, respectively. It demonstrated that LDPE plastic was more resilient than PS plastic, which was transparent, hard, but fragile, and readily shattered. Maroof (2021) revealed that 36 strains of bacteria were isolated from waste disposal sites and used to assess the degradation of low-density polyethylene (LDPE). The

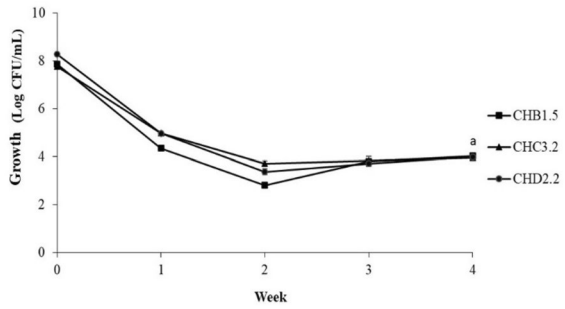

Fig. 2 The bacterial count of selected strains for biodegradation of PS plastic at various times. The error bars show standard errors. Lowercase letter indicates no significant differences in three selected strains ($p < 0.05$)

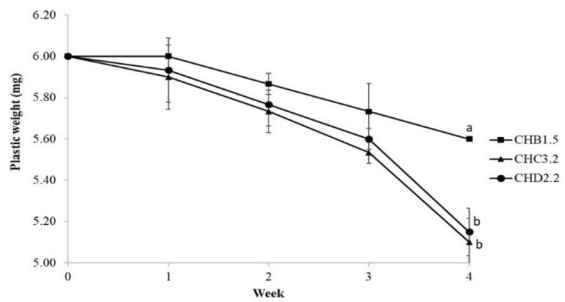

Fig. 3 The plastic weight for the biodegradation test by selected strains throughout different times. The error bars show standard errors. Different lowercase letters indicate significant differences ($p < 0.05$)

effective bacteria were identified as *Bacillus siamensis*, *Bacillus cereus*, *Bacillus wiedmannii*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, and *Acinetobacter iwoffii*, containing percentage weight loss of 8.46 ± 0.30%, 6.33 ± 0.20%, 5.39 ± 0.30%, 3.75 ± 0.10%, 1.15 ± 0.10%, and 0.76 ± 0.10%, respectively.

FTIR examination of EPS produced from PS foam food packaging treated with CHB 1.5

The findings of EPS synthesis and plastic biodegradation demonstrated that CHB 1.5 was highly efficient. Then, observing the challenge of CHB 1.5 that generated EPS from PS foam food packaging as a carbon source for 4 weeks was carried out. The results showed that the growth of CHB 1.5 was significantly increased from the beginning until weeks 2, 6.58–7.52 Log CFU/mL. Then, the growth was in a stationary phase at 7.58–7.53 Log CFU/mL for weeks 3–4, respectively. While EPS production was slightly increased for the first and second weeks, at 0.09 ± 0.03 and 0.08 ± 0.03 g/L, respectively. For the third and fourth weeks, they were able to generate EPS that increased noticeably (0.90 ± 0.16 and 1.36 ± 0.08 g/L, respectively) (Fig. 4a). As demonstrated in Fig. 4b, the EPS substance was extracted using cold acetone. Moreover, the plastic weight was decreased at the fourth week, which contained the percentage of weight loss with 1.02 ± 0.30% for the inoculation CHB 1.5 set (Table 2). These results indicated that CHB 1.5 could use PS plastic as a carbon source. Compared to Chaudhary et al. (2020), who reported that only the biodegradation PS samples with *Cephalosporium* sp. (the percentage of weight loss of 2.17 ± 0.16%) and *Mucor* sp. (the percentage of weight loss of 1.81 ± 0.13%) were evaluated for 8 weeks, but no report about EPS production. Our study showed lower weight loss due to the short biodegradation period of 4 weeks. However, EPS production was significantly increased over time by the CHB 1.5 strain (Fig. 4a). The degree of EPS secretion was more effective than Ji et al. (2024), who found that the strain *Bacillus safensis* BS-10 produced roughly 0.20 g/L of EPS at 30 days on the LDPE film. Previous studies revealed that culturing investigations using plastics as a sole carbon source led to the accumulation of members such as *Pseudomonas*, *Azotobacter*, *Bacillus*, and *Rhodococcus* (Amaral-Zettler et al. 2020; Du et al. 2022). Microorganisms attach to the plastic surface, which creating biofilms known

Table 2 The amount of plastic weight and the percentage of weight loss in the fourth week were investigated to assess using the CHB 1.5 strain in a modified MSM medium with PS plastic as a carbon source for biodegradation

Treatment	Plastic weight for the beginning (mg)	Plastic weight for the 4th week (mg)	Percentage weight loss (%)
Control	75.0 ± 0.00	75.0 ± 0.00	0.00 ± 0.00[b]
CHB 1.5	75.0 ± 0.00	74.2 ± 0.23	1.02 ± 0.30[a]

Different lowercase letters indicate significant differences ($p < 0.05$)

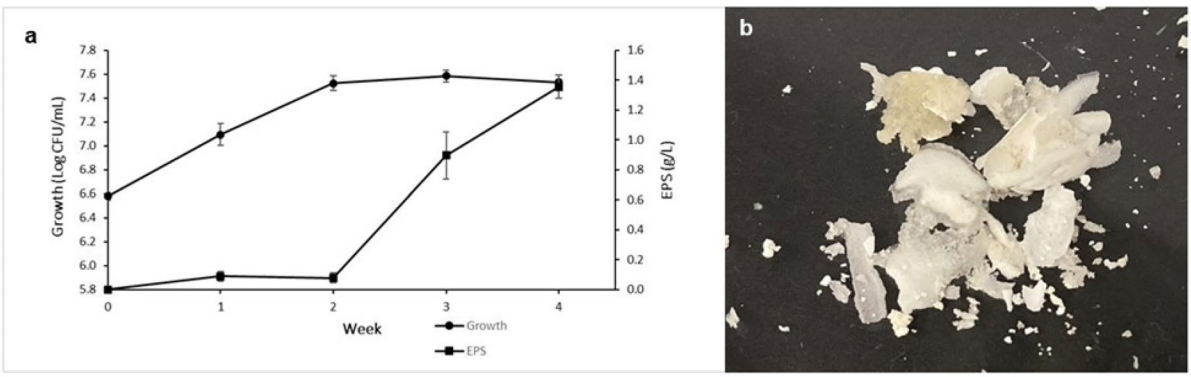

Fig. 4 Biodegradation of PS plastic as a carbon source in modified MSM medium treated with CHB 1.5 strain; **a** the growth and EPS production were performed by CHB 1.5 and **b** the presence of EPS was established after extraction using cold acetone. The error bars show standard errors

as plastispheres. The plastisphere generally involves microbial attachment that secretes extracellular polymeric substances (Zettler et al. 2013; Du et al. 2022) which promote surface adherence and cell interactions (Dussud et al. 2018; Zhai et al. 2023). In order to increase EPS yield in this study, other factors may be optimized for EPS synthesis in future experiments, such as inoculum size and nitrogen source.

FTIR spectroscopy analysis was performed to investigate the functional groups of EPS during the 4000–400 cm^{-1} spectral range. The FTIR investigation was found to have clear absorption peaks at 3229, 1649, 1454, 1275, 1070, 988, 935, 830, 613, 508 and 446 cm^{-1} (Fig. 5). The large absorption peak at 3200–3300 cm^{-1} are ascribed to the stretching vibration of strong hydroxyl groups (O–H) in EPS chains, which may involve intra- and intermolecular bonding (Kanmani et al. 2013; Sirin and Aslim 2020; Abdelmonem et al. 2024). A strong signal at 3300 cm^{-1} indicates O–H stretching vibrations of α-carboxylic groups present in uronic acids (Ventorino et al. 2019). The C=O stretching vibrations of the peptide groups are responsible for the spectrum peak at about 1650 cm^{-1} (Li et al. 2024). The C=O stretching vibration unique to the secondary PN structure known as amides I is highlighted by the peak at 1,646 cm^{-1} (Wang et al. 2020; Zhang et al. 2024). Omoike and Chorover (2004) revealed that the amide I band is changed from 1652 to 1644 cm^{-1}. The ring structure of galactose and mannose was reported in the range of peaks at 1593–1662 cm^{-1} (Freitas et al. 2009; Kumar et al. 2024). The degree of H-bonding is reflected in the intensity of the 1275–1200 cm^{-1} band (asymmetric PO_2^-stretch) (Omoike and Chorover 2004). The fingerprint zone is defined as peaks in the 1200–900 cm^{-1} range, which are considered to be called on by the polysaccharide composition of EPS (Kavita et al. 2014; Kumar et al. 2024). Omoike and Chorover (2004) also reported that DNA/RNA and polysaccharide bond vibrations are the source of groups in the 900–1200 cm^{-1} frequency range. The peaks between 690 and 515 cm^{-1} are created by the

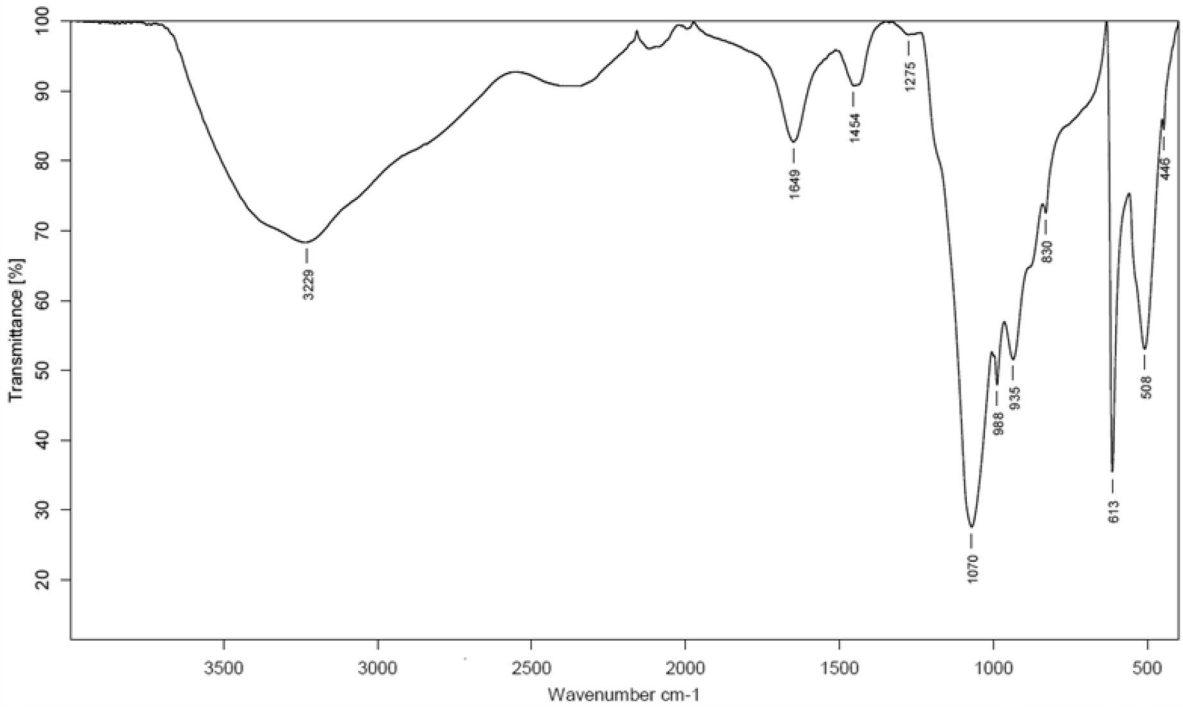

Fig. 5 FTIR analysis of EPS generated by the CHB 1.5 strain in a modified MSM medium with PS plastic serving as a carbon source

bending vibrations of C–H and C–C bonds in aliphatic compounds as well as the out-of-plane bending vibrations of substituted benzene rings (Kavita et al. 2013; Kumar et al. 2024).

SEM image for biodegradation treated by CHB 1.5 strain

With great effectiveness of plastic digestion (PS foam food packaging) and EPS formation, the adherence of CHB 1.5 isolate to plastic was confirmed using a SEM image. Figure 6a clearly demonstrated the adhesion of this strain. Based on the growth effect of bacteria and plastic weight data, plastic can be used as a carbon source for the growth of this strain, which led to a reduction in plastic weight (Fig. 4a and Table 2). Furthermore, it was observed on the plastic sheet that it resembled EPS adherence to plastic (Fig. 6b). This result supported the creation of EPS from CHB 1.5 (Table 1 and Fig. 4a). According to Ji et al. (2024) revealed that the strain *Bacillus safensis* (BS-10L) was treated with plasma enhanced the efficiency of LDPE surface biodegradation using SEM. After 30 days, cracks started to show on the LDPE film surface. Film degradation may result from biofilms that bacteria colonized and built on the surface of LDPE films.

Conclusions

A total of 35 isolates of plastic-digesting bacteria and their Gram-positive presence were discovered. The selected bacteria were CHB1.5, CHD2.2, and CHC3.2 for the highest value of OD 600 nm. The EPS extraction results showed that, after being cultivated on NB medium, CHB1.5 produced the highest number of EPS (13.47 ± 0.10 g/L), followed by CHD2.2 (8.44 ± 0.91 g/L) and CHC3.2 (4.89 ± 0.91 g/L). Plastic biodegradation was

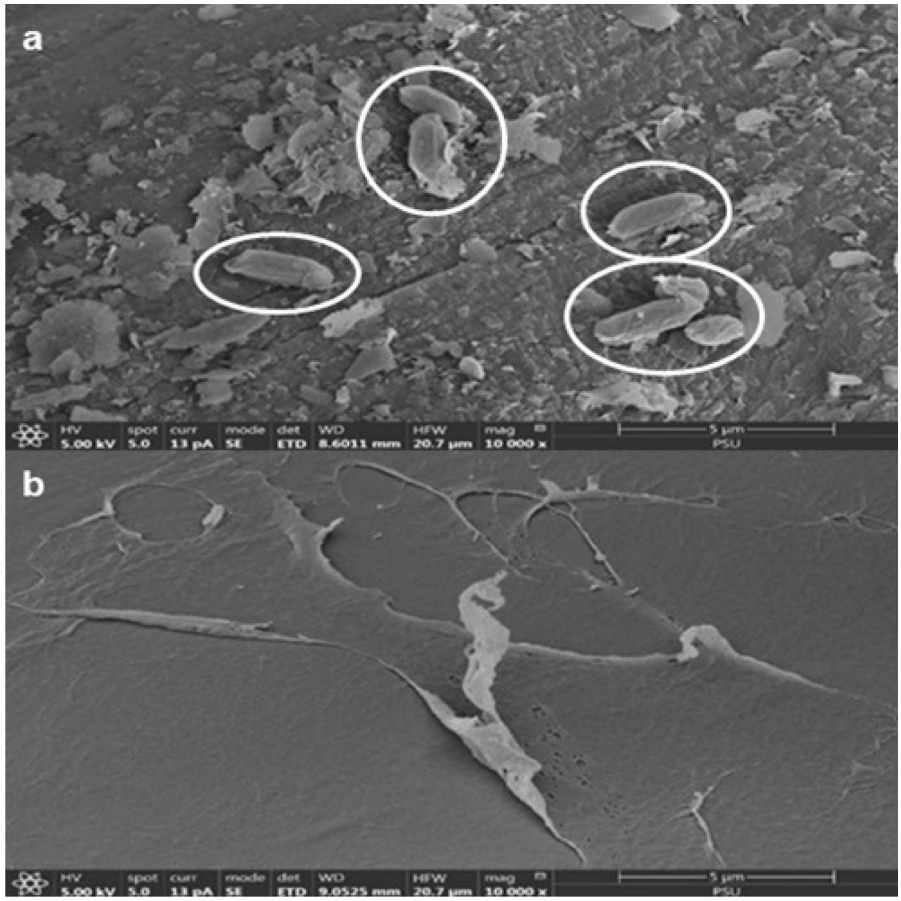

Fig. 6 SEM images showed the biodegradation of PS plastic by CHB 1.5 in a modified MSM medium at week four; **a** CHB 1.5 isolate adhered to a PS plastic sheet; and **b** EPS was produced by CHB 1.5 on a PS plastic sheet

observed on the selected isolates for a period of 4 weeks. The findings showed that the growth of three isolates was lower in the second week compared to the first. However, the number of bacteria increased gradually in weeks 3 and 4. CHB1.5 showed the highest number of bacteria (4.03 ± 0.02 log CFU/g) in week 4, although there was no significant difference. Plastic was digested by CHC3.2 isolate that showed the highest percent weight loss (15.00%), followed by 14.17% of CHD2.2 and 6.67% of CHB1.5. Furthermore, the examination of EPS production from PS plastic as a carbon source was conducted and treated with CHB 1.5 strain. CHB 1.5 was grown and produced EPS, generating 7.53 Log CFU/mL and 1.36 ± 0.08 g/L, respectively. The FTIR investigation was found to have clear absorption peaks and revealed the presence of amides I, polysaccharides, benzene rings, and hydroxyl groups (O–H). Then, the adhesion of CHB 1.5 to the plastic sheet was evaluated and showed in SEM images, as well as their EPS creation. Consequently, the CHB 1.5 demonstrated efficacy in treating environmental pollutants and could discover several applications in the future. Enhancing EPS production and characterizing it for industrial application requires testing, such as antioxidant and antibacterial activities, for utilization in food, pharmaceuticals, and biomedicine. Additionally, rapid biodegradation poses special challenges for pilot-scale deployment.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Conflict of interests The authors declare no competing interests.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

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