RESEARCH ARTICLE

Nanosized Drug Loaded Dispersion System Using Novel Isolated Biomaterial as Drug Release Modifier. It's Development, Characterization and Release study

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ABSTRACT
Epilepsy is a chronic brain illness that manifests as seizures, which are episodes of abnormal electrical activity in the brain. This study aimed to create the model drug-PHT-loaded bionanodispersion, reduce the long-term treatment expenses for epilepsy, and enhance therapeutic efficacy by utilizing the novel bioretardant from Juglans regia (JR). In order to create a nanocapsulated dispersion system, a new bioretardant with exceptional inherent characteristics was extracted. For the planning of details PLBND1 through PLBND5, various ratios of the bioretardant and the model drug, PHT, were used: 1:2, 1:3, 1:4, 1:5, and 1:8. Dispersibility, pH, % entrapment efficiency, stability studies, and in vitro drug discharge were evaluated for the bionanodispersion. With a t50% of 17.21 hours and an estimated r2 of 0.9974, the formulation PLBND2 with a 1:4 drug bioretardant proportion demonstrated noteworthy results for a number of evaluations. In 36 hours, PLBND2 demonstrated a steady drug delivery rate of 93.17% ± 1.8. Using a bioretardant with a remarkable stabilizing and retardant property, the bionanodispersion was proven to be safe and stable for the administration of the nanosized model drug, PHT.

Keywords: Edible seeds, Bioretardant, Biomatrial, Nanosizing, Bionanodispersion, Epilepsy

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INTRODUCTION
Polymers are essential for overcoming the numerous obstacles that come up during the design phase of a medication delivery system.[1] These are employed to provide the medication at a regulated time and pace. When it comes to regulated, sustained, prolonged, and delayed administration to the optimal targets, hydrophilic and lipophilic polymers are your best bet. This is distinct from the unit procedures, such as chemical treatment measures, that are used to prepare these synthetic and semisynthetic polymers. Synthetic and semisynthetic polymers come with significant manufacturing costs and compatibility difficulties that many explorers are now evaluating. Therefore, alternatives to synthetic and semisynthetic polymers that are less harmful to the environment and human health are being investigated. Researchers creating innovative drug delivery system architectures are interested in bioretardants as an alternative to synthetic and semisynthetic polymers.[2] Natural polymers called bioretardants are uncommon in their ingenuity and sharpness, and they have been extracted from a wide variety of everyday materials.[3] When it comes to the therapy of central nervous system (CNS) disorders, nanoparticles are among the most well-liked transporter frameworks.[4] Because of their small size, nanoparticles may readily cross the BBB and be delivered to the brain, where they can be used for delayed medication targeting.[5] Because of their effectiveness as well as their biocompatibility and biodegradability, nanoparticles created using unique isolated bioretardants are referred to as bionanodispersions. One possible innovative medication delivery system design is a bionanodispersionfilled with the anti-epileptic medicine model drug-PHT. Epilepsy is a neurological disorder characterised by abnormal mental activity, including repeated, involuntary brain alterations. Epilepsy is characterised by abnormalities in the brain's electrical activity.[6] Symptoms of epilepsy are referred to as seizures.[7]

Numerous events and settings that change the brain's normal electrical discharge can cause epilepsy.[8-10] Using the unique biomaterial extracted from NIBS seed, a bionanodispersionhas been generated with the suspended bionanodispersions loaded with nanosized model drug-PHT. The seeds of the NIBS tree were the source of the bioretardant. Accordingly, available synthetic and semisynthetic polymers may be substituted with the

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Table 1: Formulation design of model drug-PHT loaded bionanodispersion using *NIBS* bioretardant

Formulations	PLBND1	PLBND2	PLBND3	PLBND4	PLBND5
Drug : bioretardant ratio	1:02	1:04	1:06	1:08	1:10
Model drug-PHT (mg)	10	10	10	10	10
NIBS(mg)	20	40	60	80	100
Sodium benzoate (%)	0.5	0.5	0.5	0.5	0.5
Polyvinyl alcohol (ml)	0.5	0.5	0.5	0.5	0.5
Dextrose (%)	0.5	0.5	0.5	0.5	0.5
Double distilled water (ml)	10	10	10	10	10

Table 2. Characterisation of Isolated Bioretardant

Parameters evaluated	Observation
Colour	Cream
Odour	Characteristic odor
Taste	Characteristic taste
Melting point	268°C±2 °C.
Solubility	Soluble in water and methanol
Carbohydrate	Present
Protein	Present

extracted NIBS bioretardant.[11,12] Natural biocompatibility and biodegradability are features of this pure bioretardant.

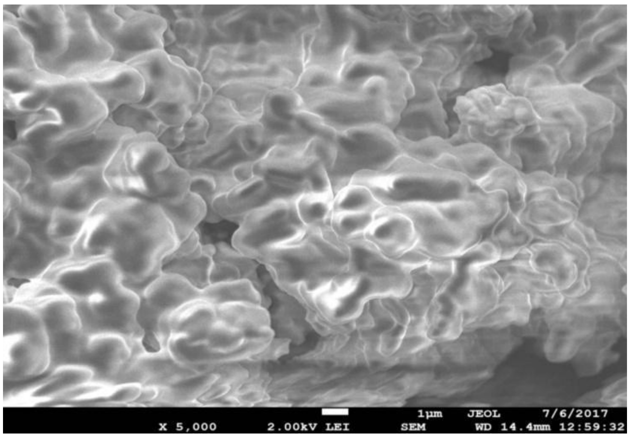

Figure. 1: SEM image of isolated bioretardant at 5000X

MATERIALS AND METHODS

Materials

Affy Pharma Private Limited, Baddi, provided a gift sample of phenytoin (model drug: PHT). NIBS was purchased at a Lucknow market. Every additional chemical that was utilized was analytical grade.

Experimental method

Isolation of bioretardant by economical method

Seeds of Juglans regia (JR) were acquired from a shop in the area. After being rinsed, 200 grammes of the seed were steeped in distilled water for 12 hours. The swollen seeds' outer layer was extracted and taken off. In a mixer, 100 milliliters of filtered water were mixed with the exposed seeds to form a paste. A muslin towel was used to strain the sludge. For ten minutes, the filtrate was centrifuged at 5000 rpm. After centrifugation, the supernatant was collected and treated with a 1:1 methanol solution. The mixture was refrigerated overnight and centrifuged the following day for 30 minutes at 5000 rpm. The sediment containing the biomaterial was collected and left to air dry while the supernatant was disposed of. The yield was calculated following numerous cycles of this biomaterial isolation procedure. Following collection, the biomaterial was dried in a desiccator until it could be used again after being sieved using a No. 200 mesh screen.[13]

Yield of biomaterial

Six independent calculations of the yield were made using a digital scale. This was determined by multiplying the mass of the extracted crude material by 100 and comparing it to the mass of the dry bioretardant powder that was separated. The standard deviation approach was used to determine the yield % of the bioretardant after the total amount that was isolated was noted.

Characterisation of biomaterial

Colour, aroma, flavour, and solubility were all used to illustrate the bioretardant's physicochemical profile. Protein and starch content were measured using techniques developed in the lab. The included bioretardant was also thoroughly examined using SEM analysis, DSC testing, FTIR spectroscopy, mass spectroscopy, and nuclear magnetic resonance spectroscopy. A computerised pH monitor (Systronics, India) was used to determine the pH for the 1% watery arrangement. There were three total tests conducted (n = 3). Biomaterial solubility was evaluated, and (n = 3) were the results. Biomaterials' particle sizes were also analysed. An optical microscope technique was used to accomplish this. About a hundred particles were counted, and the transport of molecules of varying sizes was determined, throughout the evaluation. This was a collaborative effort among the three of us.

Rheological properties of biomaterial

The powder was tapped 20 times in a tap density instrument to ascertain its density. The bioretardant's angle of repose has been calculated. The tan-1 ratio between the height and width of the stack was used to determine the equilibrium point. The findings were connected. In order to guarantee the qualities of the stream, the percentage consolidation index was used.

Scanning electron microscopy of biomaterial

In order to examine the isolated bioretardant, a scanning electron microscope (JSM-7610F) was used. Using a sputter coater in a vacuum, a little quantity of bioretardant was adhered to aluminium studs and then coated with gold. Different levels of magnification were used to acquire the photos.

Spectral Analysis

FTIR Spectroscopy, Differential Examining Calorimetry (DSC), Mass Spectroscopy, NMR spectroscopy of biomaterial

The FTIR spectroscopy was completed once the KBr plates were installed. During a differential scanning

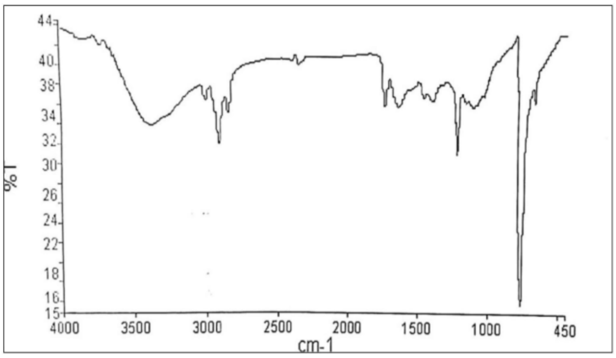

Figure.2: FTIR Spectra of bioretardant

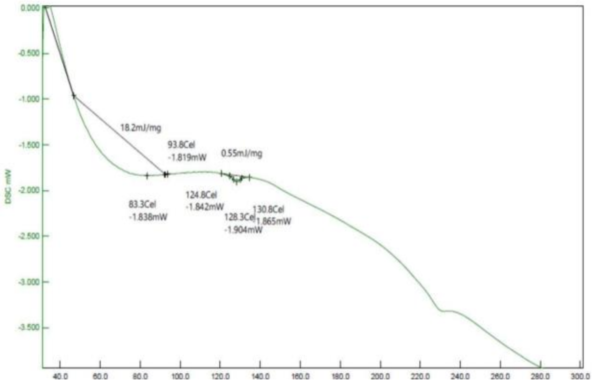

Figure.3: DSC of bioretardant

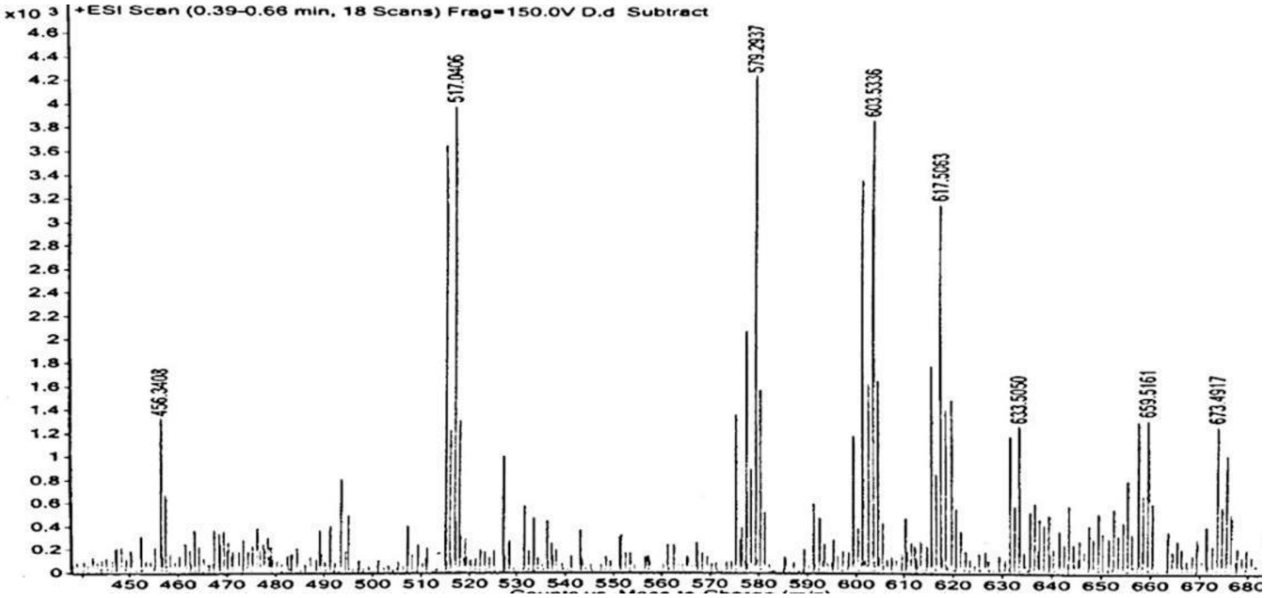

Figure.4: High-resolution Mass Spectrum of isolated bioretardant

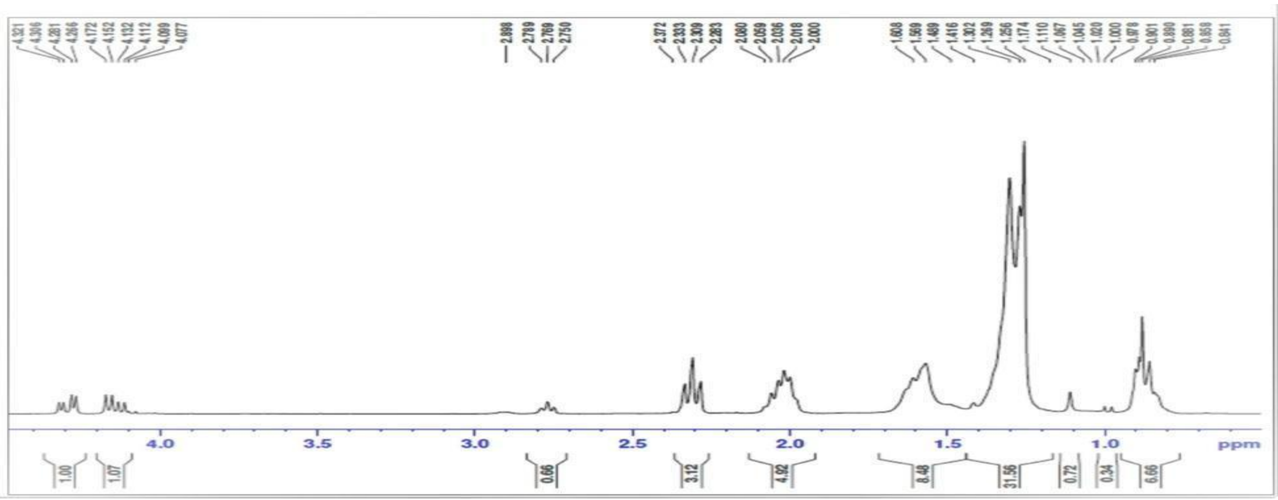

Figure 5: NMR Spectra of bioretardant

calorimetry (DSC) experiment, the amount of heat flowing into or out of an example is calculated to reveal its thermal capacity. NMR spectroscopy was been out to investigate a mysterious bioretardant in isolation.

Cytotoxicity evaluation of bioretardant on neuroblastoma cell line

The neuroblastoma cell line was used to test the inactive bioretardant's cytotoxicity. Thermo Scientific's antibiotic-antimycotic combination, fetal cow-like serum (FBS), ham F-12 medium, and Sigma Aldrich's MTT reagent were used to cultivate the human breast cancer cell line SHSY-5Y.

Nanosizing of model drug

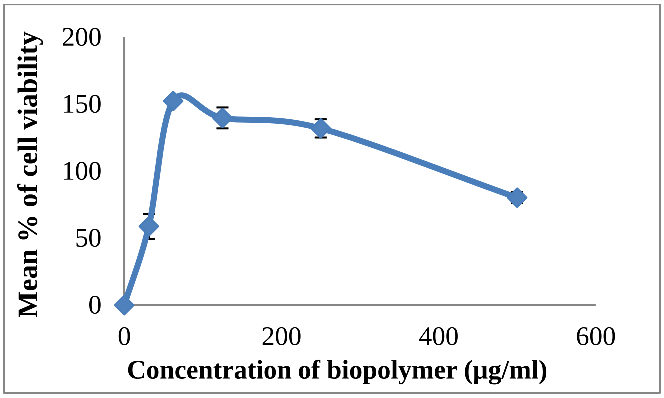

Figure. 6: Cell-line toxicity graph of concentration of bioretardant versus mean % of cell viability.

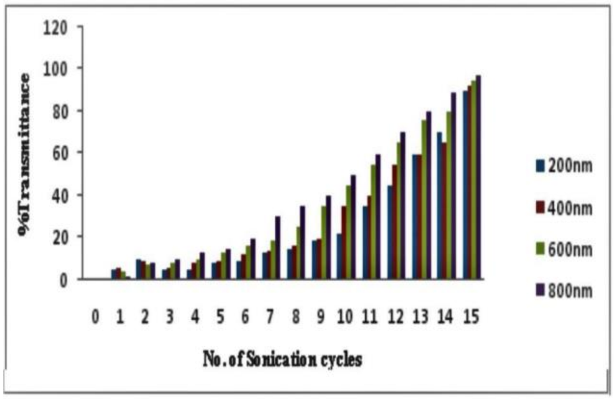

Figure. 7: % Transmittance measurement

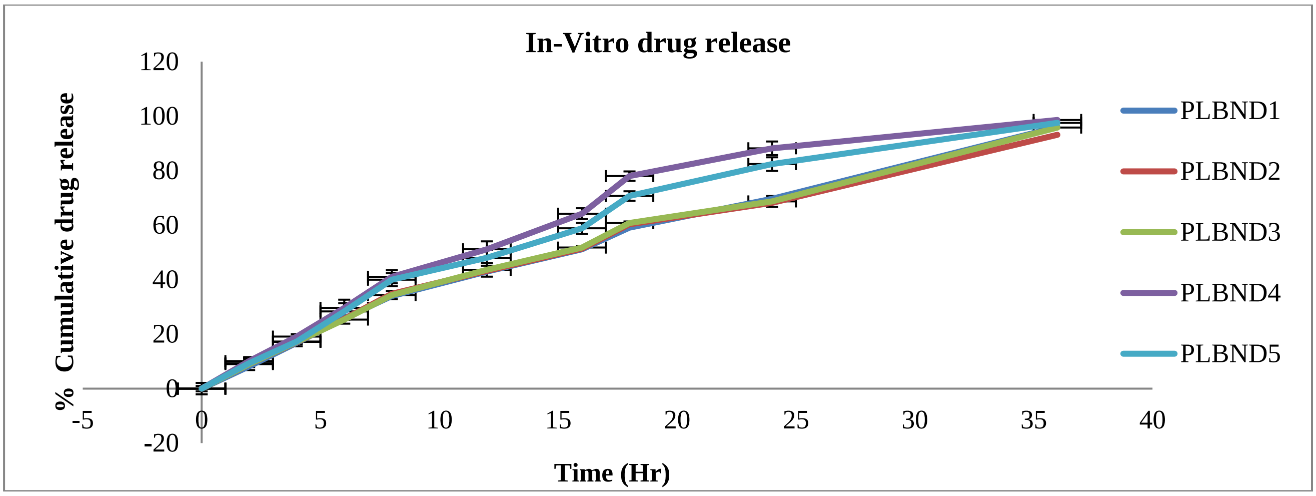

Figure.8: *In vitro* release drug profile of bionanodispersion PLBND1 – PLBND5. The results are expressed as mean ± SD (n=3)

It was decided to dissolve 500 mg of model drug-PHT in 25 cc of methanol. For 15 cycles, we continuously sonicated the suitable setup. Drop by drop, 25 ml of distilled water was added during sonication until precipitation occurred. After that, centrifugation was performed on the model drug-PHT suspension. Absorbance, percent transmittance, and percent blockage (100 - percent transmittance) were calculated on the sample after each sonication cycle. The residue was extracted and dried such that the nanoparticle model drug-PHT could be collected. The dried model drug-PHT that had been nanosized was then packaged and stored. Tyagi and Madhav (2019) reported a similar new sonication approach for nanosizing model drug-PHT. [14]

Drug-biomaterials compatibility studies

Utilizing UV spectroscopy, the drug-bioretardant interaction was investigated. In order to eliminate the water, the model drug-PHT and bioretardant are arranged in a 1:1, 1:3, or 3:1 ratio, moistened with 1 milliliter of purified water, and then dried at 50 degrees Celsius for an hour. Prior to max being resolved and repeatedly performed, the model drug, PHT, was dissolved in methanol and added to the dry mixture. In the dry approach, the three different drug-bioretardant proportions were arranged similarly to the wet method. The model drug, PHT, was then treated with methanol to break it down, and the maximum was then calculated. This subject was brought up repeatedly. Max was considered when searching for variations.

Formulation bionanodispersion

Table 1 outlines the steps required to create a bionanodispersion using a range of medication bioretardant concentrations. To make the bionanodispersion, the drug and bioretardant were sonicated with a variety of excipients, including distilled water, sodium benzoate as a preservative, polyvinyl alcohol as a suspending agent, and dextrose as a nanoszent. Excipients such as model drug-PHT, NIBS bioretardant, and some purified water were ground and combined with great care. Three sonication cycles were applied to this mixture. After that, we added 0.5 ml of polyvinyl alcohol at 0.5% concentration while sonicating. Double-distilled water containing 0.5% sodium benzoate was used to get the total amount to 10 ml. Considered sonication for 15 cycles while adding 10 mg of dextrose as a nanosizing agent. The bionanodispersion was sonicated, then chilled for two days. If there's no sign of settling, it means the details has been fine-tuned. “0.5 ml of 0.5% polyvinyl alcohol was added”, and the mixture was sonicated for 10 cycles before being placed in the

Table 3. Characteristics of PLBND1-PLBND5

Formulation Code	Dispersibility	Observed pH	Entrapment Efficacy (%)
PLBND1	Positive	7.3±0.20	86.29±1.66
PLBND2	Positive	7.4±0.14	83.17±1.24
PLBND 3	Positive	7.4±0.02	78.36±0.54
PLBND4	Positive	7.3±0.36	82.27±1.24
PLBND5	Positive	7.2±0.34	84.47±1.42

Table 4. Kinetic model fitting in PLBND1-PLBND5

Formulation	Zero - order r^2	First - order r^2	Higuchi matrix r^2	Korsmeyer-Peppas r^2	Hixon Crowell model r^2	n	Best fit model	Mechanism of release
PLBND1	0.9622	0.9445	0.9234	0.9832	0.98654	0.823	Koresmayer Peppas	Anomalous Transport
PLBND2	0.9722	0.9974	0.95155	0.9977	0.9721	0.898	Koresmayer Peppas	Anomalous Transport
PLBND3	0.9723	0.9019	0.9034	0.9934	0.9722	0.806	Koresmayer Peppas	Anomalous Transport
PLBND4	0.9423	0.9522	0.9744	0.9355	0.9566	0.897	Hixon Crowell	Anomolous Transport
PLBND5	0.9533	0.9344	0.9223	0.9634	0.9734	0.895	First Order	Anomalous Transport

refrigerator for 48 hours to see whether any settlement had occurred. After optimising the different formulas, PLBND1 – PLBND5 were made. Following its creation, drug-loaded bionanodispersion containing suspended nanoparticles was characterised by measuring the following variables.[15]

Characterization of bionanodispersion

Dispersibility and pH

Twenty milliliters of sterile water were used to suspend twenty milligrams of the nanoparticles for examination. After waiting for the nanoparticles in suspension to settle to the bottom, they were redistributed and monitored once again to ensure proper redistribution. Any kind of lump or precipitation formation after the tremors was seen. Three times the surgery was performed and evaluated. An accurate pH metre was used to measure the bionanodispersion's intended pH level. A three-sample average was obtained and tracked to see whether the pH of the nanosuspension met the minimum threshold.

Entrapment efficacy

The effectiveness of the bionanodispersion's trapping was calculated. An ultracentrifuge was used to spin down the freshly made bionanodispersionat a rate of 2,000 rpm. The drug unincorporated concentration was determined by diluting the supernatant collected after centrifugation and measuring the absorbance at 216 nm using ultraviolet (UV) spectroscopy. This verification was performed three times, and the average was established.

Particle size screening of bionanodispersion

By monitoring the bionanodispersion's spread, its efficacy was evaluated. The sonication technique was used to examine the transmittance as a function of particle size in the nano range. The percentage of particles below and above the range that must be communicated is determined by the particle size range at a specific range. Before and after the sonication cycle, the transmittance percentage was assessed. The transmittance percentage was calculated after each sonication cycle to ascertain the impact of sonication on the transmittance.[16]

In-vitro drug release study

Prior to release, each component was tested in vitro. Using the M.S. (Madhav-Shankar) diffusion apparatus and a unique static approach, an in-vitro release investigation was carried out. The gadget is divided into two sections: one for collectors and one for donors. Donor (1 ml) compartments were filled with the release study formulation, and the ends were sealed with the egg biomembrane. A receiver chamber containing 13 milliliters of a 7.4 pH phosphate buffer solution was submerged in the donor chamber. For 36 hours, samples were taken at regular intervals.

After every collection, the phosphate buffer solutions were discarded and replaced with new ones.[17] The amount of medication emitted from the samples was measured using a UV Spectrophotometer study. A line graph showing the percentage CDR over time was also created. Kinetic analysis for many formulations, evaluation of release studies, and selection of the best-optimized formulation required the determination of other parameters such as r2, t_{50}, and t80%.

Stability

ICH guidelines were followed in the run-up to the stability trial. The bionanodispersion was stored for six months at a range of temperatures. In a stability chamber, the bionanodispersion was maintained at two different temperatures and relative humidities: "25°C2 °C, 60% RH, and 40°C2 °C, 75% RH". Throughout the testing process, we kept an eye on the samples and recorded their values at regular intervals. The drug concentration, pH fluctuations, colour, appearance, encapsulation effectiveness, and in vitro release were all monitored in the bionanoformulations under evaluation.

RESULTS AND DISCUSSION

General Appearance and Yield

The NIBS bioretardant that was isolated displayed a whitish-cream hue. It was found that the isolated bioretardant yield was 8±1.2%.It was found that 275 ±4 oC was the color-changing point. This suggests that the natural kernels were separated into a critical yield.

Physicochemical properties of bioretardant

Physicochemical depictions have shown that bioretardant has a distinctive flavour. The bioretardant was discovered to dissolve in methanol and water but not in diethyl ether or acetone.The presence of the tested substances, such as protein and carbs, was verified by chemical analysis. These polymeric properties are shown by the presence of high molecular weight components. Table 2 summarises how researchers' minds worked as they uncovered different parameters of NIBS's separated bioretardant.

Particle size analysis of biomaterial

The isolated bioretardant has a particle size distribution of 45.22-301.80 micrometer. The results show that the bioretardant has a granular, flaky texture and varied molecular size. The grainy, flaky look was also linked to the SEM image. It was found that the particles resembled typical polymers.

Rheological properties

Its unique rheological characteristics, such as its bulk density of 0.66±012 g/cm3, its tapped “density of 0.9±0.11 g/cm3, and its consolidation index of 13.5±1.2%, showed satisfactory results”. As a result, it was discovered that the isolated bioretardant was suitable for creating bionanodispersion and free-flowing.

Scanning Electron Microscopy

SEM analysis of purified NIBS bioretardant revealed a granular and flaky surface texture. Its polymeric origin is confirmed by its granular and flaky patterns. Figure 1 shows a scanning electron micrograph of the hidden bioretardant.

FTIR,DSC, Mass and NMR Spectroscopy

Functional groups such as hydroxyl (3395.29 cm-1), alkynes (668.01 cm-1), carboxylic group (1380.63 cm-1), and others like amide at 1638.82 cm-1 and alkenes at 2926 cm-1 were detected in the bioretardant's FTIR spectrum. It has the same polymeric characteristics as other synthesized and semisynthetic polymers because of these functional groups. FTIR spectrum is seen in Figure 2.

DSC peaks for NIBS biomaterial were found at 83.27 °C and 128.3 °C. The area is 18.24 mj/mg and the density is 0.55 mj/mg. Its polymeric nature is confirmed by the obtained result. As seen in Fig. 3, the large endothermic peak indicates the polymeric nature. Due to its high molecular weight structure, the isolated biomaterial is shown to be polymeric using mass spectrometry. Proteins are confirmed to be present when a high molecular weight is found. According to high-resolution mass spectra of purified bioretardants, “the parent peak was located at m/j 579.29”. As can be seen in Fig. 4, its large molecular weight is indicative of its polymeric nature. Alkyl groups can be identified by the NMR spectrum peak at 0.90ppm, methylene groups by the peak at 1.25ppm, hydroxyl groups by the peak at 1.26ppm, ester groups by the peak at 2.3ppm, and aliphatic methylene proton by the peak at 4.2ppm. These groups' presence validates its polymeric nature, as seen in Fig. 5.

Cell Line Toxicity study of bioretardant

When tested for toxicity against cell lines, biomaterial derived from NIBS revealed an IC50 value of >500 g/ml, with the mean percentage of cell viability decreasing from 155.34±1.44% to 57.84±1.88%. In this method, the data from the cell feasibility study may prove that the investigation did not detect any cell death. In addition, the bioretardant's estimated IC_{50} value was higher than 100 g/ml. Based on the data collected, it is clear that bioretardant is safe and non-harmful in its natural state. This indicates that it is safe to employ while creating drug-loaded bionanodispersion. Figure 6 is a graph depicting the relationship between bioretardant concentration and the mean percentage of cell viability in cell lines.

Nanosizing of model drug-PHT

Nanosizing shown by UV screening that model drug-PHT particle size varies in the nanosize range. Following each three-minute sonication cycle used in the model drug-PHT nanosizing process, the sample's percent transmittance was measured to confirm that the percentage of delivery increased with increasing cycle count. This was due to the fact that the particles became nanoscale. According to Madhav and Raina (2019), blocking revealed a proportion of particles larger than 400 nm, while bionanodispersion transmission revealed a percentage of particles smaller than 400 nm (Fig. 7).

Drug-biomaterial compatibility

The maximum wavelength (216 nm) in the pharmacological excipients examination did not significantly alter before or after the test. The maximum concentrations (max) of the pure drug and the drug-bioretardant combination were found to be almost the same. If the maximum was not appreciably different from that of a pure drug, there was no interaction between the drug, the bioretardant, and other excipients. For the isolated bioretardant to be used in the production of bionanodispersion, it was seen and confirmed that excipients are not interacting and changing therapeutic characteristics .

Study of model drug-PHT loaded bionanodispersion

PLBND1–PLBND5 bionanodispersions were created with a variety of drug-polymer ratios. Tests on the chosen PLBND1–PLBND5 included dispersibility, pH analyses, percentage efficacy, UV screening of bionanodispersion particle size, and in vitro release investigations. The pictures below depict what we discovered.

Dispersibility and pH

The generated bionanodispersions were shown to disperse well. It was also decided that the redistribution was fine. During the scattering analysis, all bionanocapsules were shown to be dispersed (Table 2). There was no clustering or jumbled appearance. Table 3 shows that the pH of the bionanodispersions ranges from 7.2±0.34 to 7.4±0.14 (Table 3). This indicates that the pH values were within the range necessary for the formulation of bionanocapsules to be effective.

Entrapment efficacy

The formulated bionanodispersion's ensnarement viability ranged from 78.36±0.54% to 86.29±1.66% (Table 2).The bionanodispersion that was defined demonstrated the highest trapping efficacy, reaching 86.29±1.66%. As a result, the model drug-PHT was most entrapped in the stable bionanodispersion that was created.

Particle size screening

Nanoparticles were present in every sample of the bionanodispersion formulation (PLBND1–PLBND5). The size of the nanoparticles in the sonicated bionanodispersion was screened using a UV technique. Since the molecule size is now in the nano range after sonication, increasing the sonication cycle was observed to enhance the transmittance percentage. When particles were screened using UV spectrophotometry, the transmittance indicated the percentage of particles below 400 nm and the percentage barrier indicated the percentage of particles beyond 400 nm .[18]

In-vitro release study

A modified M.S. diffusion device was used for the in vitro release analysis. BITS-SOFT1.12 was used to complete the release kinetics analysis; 50% and 80%, r2, values were calculated. Drug release was more than or equal to 93.49 % ± 2.4 across all formulations (Fig. 8). Drug release was shown to range from 93.49 % ± 2.4 to 97.77% ± 1.6. in in-vitro release studies of different formulations. The bionanodispersion PLBND2 was the most effective formulation, with a half-life of 17.21 hours, an estimated r2 of 0.9974, and a drug delivery rate of 93.17 % ± 1.8 after 36 hours. Anomalous transport was identified to be the mechanism of drug discharge based on the results of the kinetic tests (Table 3). A significant release of model drug-PHT was observed in a bionanodispersion prepared with a 1: 4 ratio of medication to bioretardant. The in vitro release analysis and release kinetics of all the formulations demonstrated that supported delivery of the model drug-PHT from the stable PLBND2 was accomplished. The isolated bioretardant from NIBS seed was afterwards revealed to have excellent control over the delivery rate in addition to fantastic intrinsic bioretardant cum stabilizer activity. Among them, the formulation consisting of a 1:4 of medication to bioretardant (PLBND2) had the highest model drug-PHT release.

The best-fit model is “Korsmeyer-Peppas, and the mechanism of drug release is anomalous transport”, as determined by PLBND2. Because of its revolutionary integrated bioretardant characteristic, bioretardant offers a long-term solution to the problem of treating epilepsy.

Stability

No noticeable difference was seen in max, ensnarement adequacy, or drug discharge as a result of the improved details. Therefore, no medication was lost throughout the period of observation. The results from the other evaluation criteria were also encouraging. The most optimized formulation, PLBND2, was shown to maintain its physical and chemical qualities throughout the study periods.

The formulation's chemical and physical stability, as well as its compatibility with the isolated bioretardant, were confirmed by the results obtained during the testing period.

When creating nanocarriers, a number of potential challenges might arise. such as stability, drug entrapment efficiency, and site-specific distribution of the drug moiety. In this work, we aim to develop a model drug-PHT-loaded bionanodispersion with dispersed nanoparticles using a novel bioretardant made from JR seeds. Because of its inherent bio-stabilizing capabilities, bionanodispersiongreatly reduces the main problem with any dispersion system. The nanosized model drug-PHT in the bionanodispersionformulation was stable enough for human use. Whether looking at the cumulative duration of model drug-PHT administration or the stability time frame, using nanosized model drug-PHT in the creation of the bionanodispersionyielded excellent results (Tyagi and Madhav, 2019). As such, the unique bioretardant became an important bioexcipient in the development of bionanodispersion. With a drug bioretardant to carrier nanoparticle ratio of 1:4, PLBND2 demonstrated an excellent capture efficiency (86.29±1.66), pH (7.4±0.14), drug release (93.17 % ± 1.8 in 36 hours), and considerable stability. The results show that it is suitable for use with model drug-PHT in bio-nanosuspension. These results suggest that everyday bioretardant may be used as a new bioexcipient in the development of stable bionanodispersion.

The biodegradability and biocompatibility of bioretardant derived from common sources make it a competitive substitute for traditional synthetic and semisynthetic polymers. One of the most impressive biomaterials that occurs in nature is bioretardant. However, there hasn't been much research on its intrigue. For the long-term treatment of epilepsy, however, the bioretardant may now be safely exploited as a novel biomaterial for creating bionanodispersionwith distributed drug-loaded bionanodispersions. [19]

CONCLUSION

Using the bioretardant extracted from NIBS seed oil, a model drug-PHT-loaded bionanodispersionwas created for this investigation.

Using the customized bionanodispersion PLBND2, a notable drug discharge was seen for over 36 hours. As a result, the isolated bioretardant demonstrated exceptional compatibility with the model medication, PHT, and possessed the necessary stabilizing and bioretardant properties. The isolated biomaterial, which has several promising features, could be employed as a new biomaterial in the production of bionanodispersion for the successful and economical treatment of epilepsy, according to the findings.

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